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THE HEILMANN LOCOMOTIVE.

At first sight the Heilmann system of electric traction seems to have little to recommend it to American engineers, and were it not for the serious attention which it has received in France, and the evident ability with which the details have been worked out, it would excite little or no interest on this side of the water. Among the strongest arguments in favor of the system are, that it admits of higher speeds being attained, the locomotive is more flexible, there is less wear on the rails, and tractive power is more economically generated and better distributed. In answer to most of these claims it may be said that in America no practical difficulty has been met in attaining a speed of over 100 miles with steam locomotives, and that the Empire State Express has even reached a speed of 114 miles without showing that this was at all a limit. Experience with high speeds has also shown that injury to the track from the "pounding" action of a steam locomotive is largely a bugbear. Even if some evils were mitigated by this system, the complication of machinery, including eight motors under the locomotive, would introduce other and perhaps much greater evils. The claim of greater economy in the use of fuel even cannot be accepted in the absence of direct data. It is said that a modern steam locomotive can produce a horse power under favorable conditions with 2.7 pounds of coal, and we cannot see that this can be equalled with the most economical engine than can be used in the Heilmann system, taking into consideration the losses between the generator engine and the axles of the locomotive.

THAT $50,000 PRIZE.

It is rumored that the Metropolitan Traction Company applied the original time limit and withdrew its offer of a $50,000 prize on March 1, assigning as a reason for not extending the time that the State Railroad Commission had not accepted its offer to act as a referee. A daily newspaper has published a statement supposed to emanate from the traction company to the effect that more than 1,500 plans had been submitted in competition by inventors. In return for the time and trouble thus expended inventors have received no benefit whatever, while the traction company has had placed at its temporary disposal, at no cost to it, a collection of ideas from which, had it so chosen, it could have obtained information of great value if the original intention of using some conduit system on its lines is to be carried out. It is not too much to say that inventors have not been fairly treated in this so-called competition. The time allowed to construct and operate a practical system was so absurdly short that it was taken for granted, assuming that the competition was to be a real one, that it would be extended. The condition that the State Railroad Commission should act as a referee was also seen to be an impossible one, as lying entirely beyond the province of that body, but here again the promise of the passage of a bill to give the necessary authorization was doubtless relied upon. It is true that such a bill was introduced in the Legislature, and might, it seems reasonable to suppose, have been easily pressed to passage, but, as far as we know, it was never heard of after its first introduction. It is little likely that inventors will soon again allow themselves to be thus trifled with, and the whole affair is very little to the credit of the corporation concerned.

INSTITUTE LOCAL MEETINGS.

Those who have favored the policy of holding local meetings of members of the American Institute of Electrical Engineers, the adoption of which at one time seemed problematical, will feel gratified at the complete confirmation of their views through the brilliant success of the inaugural meeting held in Chicago last week. Every promise is given by this new feature toward the extension of the usefulness of the Institute and the growth of its prestige, while the national interest that will thus be taken in its conduct will go far toward suppressing petty practices in its management. One point in this connection still requires attention, and that is to provide for the many who would attend the meetings and yet are either not members or not eligible to membership. At the recent Chicago meeting, for example, only about one-third of those in attendance were members, and it is probable that every meeting there and in New York would be largely and regularly attended by non-members, such as students and others, if some provision existed for attaching them to the meeting in an auxiliary capacity. Aside from the further extension of the usefulness of the Institute through the adoption of this policy is the question of assisting by this means in providing for the local expenses. If all of the Chicago members were to contribute pro rata to the expense of a stenographic report and the other incidental expenses, the amount would approach that of the annual Institute dues, while at the several other places where local meetings are possible, it would exceed this sum. We trust that among the other matters requiring legislative action that will come before the annual meeting of the Institute this will be included, and we would suggest that the Chicago membership, being most directly affected, take the initiative and present a plan for consideration, which might also include other points that their experience has suggested would further contribute to the success of local meetings.

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THE PROVISIONAL MAGNETIC UNITS.

The most important step ever taken by the American Institute of Electrical Engineers was the adoption at the recent meeting of the several provisional magnetic units which have been before it for consideration for some time. Should the units fail to meet with acceptance much of the prestige gained by the Institute by its able work in connection with the recent International Electrical Congress will be lost, but happily this is an eventuality little probable of realization. The units provisionally adopted are not, as supposed by many, the same as those that were considered at the Chicago Congress. The latter were a system in which arbitrary magnitudes were assigned in order to more nearly correlate magnetic units with the existing practical electrical units. The result, however, was unfortunate, not only in the extremely impractical values of several of the units, but also in the lack of a proper relation between the proposed gilbert and gauss. In the criticisms from foreign electrical bodies and other authoritative sources, the system was almost unanimously condemned, and in almost every case an opinion expressed that the magnitudes of the C. G. S. magnetic units were such as to render that system the proper one for practical adoption, and the action of the Institute seems to be based on this verdict. In view of the extreme improbability of ever successfully devising any coherent practical system on the lines of the one condemned at Chicago, and of the fact that the magnitudes of the C. G. S. offer no real practical difficulties, it may be concluded that there can be no valid criticism to their adoption as practical units, particularly as they have been thus used for years. The criticism in regard to the names, however, is not without reason. It is contended that the policy of giving Greek names to the C. G. S. units should be observed; that all of the proprieties will be violated by a mixed system in which the dyne and erg will be jostled by the oersted and gilbert. On the other hand, it is said that thus far no Greek names have been proposed for the magnetic units, even by those who have most strenuously urged that such should be adopted; that as the magnetic units are to be practical units, they should have the same nomenclature as the other practical units; and that the opportunity thus given to pay homage to other great names in electrical science should not be sacrificed to mere purist considerations. As the adoption of the names of the units will depend almost entirely upon practical men, there is little doubt as to which argument they will favor. In regard to the names themselves, every one will recognize the justice of honoring Weber and Gauss, one of whose names at least should have been used with the older system of practical units. As the founders of the systems of measurement upon which all units are based, they deserve a recognition which, now being given, should go far to outweigh the demands of purists for Greek names. As much cannot be said, however, for the other two names, gilbert and oersted. While the former had perhaps one of the greatest minds of his century, yet we are not aware that the "De Magnete" had the slightest influence on the development of electromagnetism, either directly, or indirectly through influencing the minds of the real fathers of the science. Oersted's claims are still less; his discovery of the deflection of a magnetic needle by a current, even if the first as regards time, is of the class that implies the exercise of no other faculties than those of sight and curiosity—both equally possessed by a child. With names at hand like those of Franklin, Maxwell, Hertz, Kelvin and others there is reason for objecting to the choice of gilbert and oersted. Of the four units the gauss is particularly welcome. Instead of referring to the intensity of induction of a material as so many lines of force per square centimetre we can now say that the working flux of wrought iron is, for example, 15,000 gausses, etc., thus, besides the convenience, enabling much more concrete ideas to be formed. Next in order of usefulness is perhaps the weber, as we can now express the fields of dynamos very concisely in megawebers instead of in so many million lines of force, dynamo fields ranging from two to 100 megawebers in value. At present the field of usefulness of the oersted and gilbert seems to be rather restricted. With, however, something tangible and concrete now to work with, we may soon expect the oersted to play the same part in magnetism that its analogue, the ohm, does in electricity, with the consequent result of greatly simplifying magnetic calculations. While the practical values of reluctances will be small, the history of telegraphy has shown that the use of prefixes are unobjectionable, and we may therefore expect that the use of millioersted will cause no inconvenience. Whether the gilbert, which is practically the value of an .8 ampere turn, will displace the expression now used is problematical, though the magnitude is particularly convenient. Should it not do so, no other unit of magneto-motive force can do better, as it is extremely improbable that any change will ever be made which will enable such a unit to express the value of an ampere turn by unity, or by ten or one of its powers. The workers in practical electricity have now presented to them a system of practical magnetic units which seems as well, if not better, suited to their needs than any yet devised. With them its failure or success entirely lies, for however much the devotees of pure science may object (we are not aware that they will generally object), if the system once becomes generally used in electro-technics they will be compelled to fall in line. While the system will be presented for adoption in Europe, the verdict of this country, on account of its preponderating practical influence, will determine the verdict of the world, and therefore American electricians have a double reason for giving the matter the careful consideration which it deserves.

### Coupling Alternators in Parallel.

*To the Editor of The Electrical World:*

I desire to call attention to an error of omission in Mr. Steinmetz's paper describing his most successful attempts in synchronizing alternators. The machines used have been made for several years and are not used in parallel, because as at present installed they cannot safely be coupled nor economically run.

Obviously then there is something different in the method of driving these machines which is important. On this important point Mr. Steinmetz says nothing whatever.

I am inclined to think that if any one takes Mr. Steinmetz seriously and runs his machines up as described, the results in some cases would be disastrous.

Will Mr. Steinmetz then inform us how the alternators were driven and what type of engine was used, as it has for some time been known that the parallel running of alternators is purely a mechanical problem—not an electrical one?

Gloucester, N. J. WILLIAM SMITH HORRY.

Referring to Mr. Horry's question on the mechanical conditions which have to be fulfilled for successful parallel running of alternators, I may state that there is only one condition, and that is that the alternators are run at exactly the same frequency, or, in other words, that the number of poles × number of revolutions is the same in all machines which shall be run in parallel.

Before throwing the alternators in parallel, it is necessary therefore to bring them to exactly the same frequency. It is not necessary, though desirable, for avoiding an instantaneous fluctuation in the system, that the alternators which shall be synchronized are brought to about the same voltage.

Equality of frequency, however, means not only equality of number of revolutions × by number of poles, but means that during each revolution the speed must be constant and uniform. Especially in direct connected generators, driven by badly regulated steam engines with insufficient flywheel capacity, during each revolution the speed may fluctuate considerably, which is disadvantageous for good parallel running.

Before attempting to synchronize alternators, it is necessary, therefore, to determine whether the driving power, as transmission, etc., is such as to enable the alternators to run at the same frequency. This is best done by loading both alternators up to full load independently and then noticing whether the phase indicator shows if the frequencies are near enough the same. If this is not the case, the speed has to be varied by adjusting the engine speed, changing the pulley, etc., so as to get the alternators to run at the same frequency. As soon as this is the case they may be thrown into parallel at any time without any further precautions and without any danger of getting into trouble.

CHARLES P. STEINMETZ.

### The Meeting of the American Institute of Electrical Engineers.

The eighty-fifth meeting of the American Institute of Electrical Engineers was held Wednesday evening, March 21, at headquarters, 12 West Thirty-first street, with President Houston in the chair.

By a vote of the meeting the report of the Committee on Units and Standards was taken from the table. The discussion on the units proposed for provisional adoption was participated in by Messrs. Houston, Kennelly, Crocker, Geyer and Pupin, who advocated the adoption of the report, and by Messrs. Wolcott, Hutchinson and Bradley, who criticised it. Special stress was laid by several of the first named speakers on the convenience for teaching purposes of having definite names for units, and it was also claimed that practical men had difficulty in understanding the significance of a unit until a concrete name were given. Mr. Wolcott objected to the use of proper names for C. G. S. units, and advocated the substitution of Greek derivatives similar to erg and dyne. Dr. Hutchinson took the ground that the names proposed, weber, gauss, oersted and gilbert, had been repudiated by the International Congress irrespective of their magnitude, and therefore stood little chance of being considered in other countries. Mr. Bradley thought that the names should be submitted to the various foreign electrical bodies before being adopted. The first criticism was met by the argument that as the proposed units were practical units they should have names of the same character as the other practical units, notwithstanding the difference in magnitude. In answer to the criticism of Dr. Hutchinson, it was maintained that as the function of an international congress is merely to approve what has already been generally adopted by the electrical public, the action referred to had no significance in view of the fact that the units laid before it then had not this recommendation, and that any system would first have to pass through a state of probation, as proposed, before active consideration by such a congress could be given. In answer to Mr. Bradley, it was explained that the units were to be merely previously adopted; and therefore his objection did not apply.

Prof. W. A. Anthony then read his paper on the "Effect of Heavy Gases in the Chamber of an Incandescent Lamp," which maintained that the use of bromine vapor in the chamber prevented blackening and maintained the candle power and efficiency more uniform. In the discussion Prof. Robb supported the views of Prof. Anthony, and Messrs. Howell and Doane strongly opposed them and advocated the superiority of the vacuum lamp; a great portion of this part of the discussion was merely a resume and extension of various points brought up in the recent Novak lamp suit by the same gentlemen. Written communications from Elihu Thomson and E. P. Thompson were read, and remarks made by Messrs. Moses, Hammer, Doane, Olan Bohm and others. The discussion lasted until almost midnight and extended much beyond the scope of the paper. There was a substantial agreement that the cause of blackening is the evaporation of the carbon filament, and that the presence of a dense vapor retards it, but the difference of opinion as to the ultimate benefit of such a vapor was wide. Through the courtesy of the Metropolitan Telephone and Telegraph Company, the American Telephone and Telegraph Company, and the Chicago Telephone Company, telephonic communication was established between the Chicago meeting, where Professor Anthony's paper had been read, and was being simultaneously discussed. The possibility of bringing distant audiences in touch with the author of a paper was satisfactorily established, and before adjournment, President Houston, at New York, spoke over the wire to attentive listeners in both cities, extending congratulations upon the success of the dual meeting, and informing the Chicago members that the report of the Committee on Units and Standards had been approved. About eighty members and guests were present at the New York meeting, and forty in Chicago.

At the council meeting in the afternoon, the following Associate Members were elected:

Agnew, Cornelius R., New York City; Billberg, C. O. C., Philadelphia, Pa; Bliss, William L., Brooklyn, N. Y.; Carichoff, E. R., New York City; Coho, Herbert B., New York City; Galletly, J. Fred., Chicago, Ill.; Jackson, Henry, Horwich, Bolton-le-Moors, Lancashire, England; Keller, Edwin R., Philadelphia, Pa.; Kirkland, John W., Schenectady, N. Y.; Phillips, Leo A., Newark, N. J.; Rouquette, William F. B., New York City; Rowland, Henry A., Baltimore, Md.; Smith, J. Brodie, Manchester, N. H.; Voit, Dr. Ernst, Munchen, Germany.

The following Associate Members were transferred to full membership upon recommendation of the Board of Examiners:

Almon, Geo. H., Boston, Mass.; Egger, Ernst, Vienna, Austria;

Brenner, W. H., Montreal, P. Q.; Haskins, Clark C., Chicago, Ill.; Fitzmaurice, James S., Sydney, N. S. W.

Upon recommendation of the Sub-Committee on Papers and Meetings, it was voted to hold the annual and general meetings of the Institute in Philadelphia, May 15 and 16.

As required by the rules, the council also canvassed the nominations received from the membership during the month of February, and prepared the following ticket for the coming election, ballots for which will be issued in April: For President, Prof. Edwin J. Houston; for Vice Presidents, Prof. Wm. A. Anthony, Prof. Francis B. Crocker and Mr. James Hamblet; for Managers, Messrs. A. E. Kennelly, W. D. Weaver, Chas. S. Bradley and Wm. B. Vansize; for Treasurer, Mr. Geo. M. Phelps.

### THE CHICAGO MEETING.

The meeting was called to order by Mr. Edward Caldwell, and upon motion of Mr. B. J. Arnold, Mr. Hibbard was named chairman. Prof. Anthony's paper was then read by Prof. D. C. Jackson, of the University of Wisconsin. The discussion was opened by Mr. F. E. Jackson, of the General Electric Company, who had come from the Harrison, N. J., lamp works to exhibit diagrams of Edison and Novak lamps, and reply to some of Prof. Anthony's statements, the same points being made as at the New York meeting by Mr. Howell. Further discussion was carried on by B. J. Arnold, Ludwig Gutmann, and Mr. Kammer, of the Sunbeam company. Prof. Stine also took a hand in the discussion by reading quite a lengthy paper prepared in advance. Prof. Jackson then answered a number of questions and closed the discussion on behalf of the author of the paper. Before the discussion the meeting adjourned to an adjoining room, where about 40 receivers were connected with the Institute headquarters at New York, and listened to President Houston's conversation; all could hear very distinctly, and this feature of the first local meeting was thoroughly enjoyed. At the close of the discussion of the paper, a vote of thanks was tendered to Mr. Hibbard, as the representative of the Chicago Telephone Company, and to Mr. Hall, as the representative of the New York company, for the use of the telephone lines, and also to Prof. Jackson and to Mr. F. E. Jackson for their interest in coming such long distances to attend the meeting. Prof. Stine and the Armour Institute, which have placed admirable facilities at the disposition of the local meeting, also came in for a very hearty vote of thanks for their hospitality. Prof. Stine, B. J. Arnold and Edward Caldwell were appointed a committee to devise means to pay local expenses and to arrange from time to time for the holding of meetings. Among the members present, besides those mentioned above, were Lieut. Rodman, Mr. McFadden, Mr. Comstock, C. C. Haskins, and others. Among non-members were Mr. Terry, of the Sunbeam company; Mr. Kammer, of the same company, and a number of telephone people, and others connected with the city Electric Light Inspection Department, the entire attendance numbering more than forty.

## Lamp Socket Decisions.

Judge Coxe last week, in the case of the Edison Electric Light Company against the Syracuse Electric Engineering and Supply Company, rendered an opinion in regard to four patents relating to incandescent lamp sockets.

One of these (No. 265,311) is a fundamental patent covering sockets adapted to be placed upon a gas pipe or other suitable support and provided with contact plates for the circuit terminals. This patent was declared valid, but it was also decided that it had expired in December, 1891, with the Russian patent.

Another fundamental patent (251,596), relating to the combination of the interior insulating portion of a socket with circuit connections and an exterior metal portion forming a covering, was declared invalid.

Two patents covering the Edison type of socket and the use of a removable rubber ring in a socket were sustained.

## Communications with Vessels.

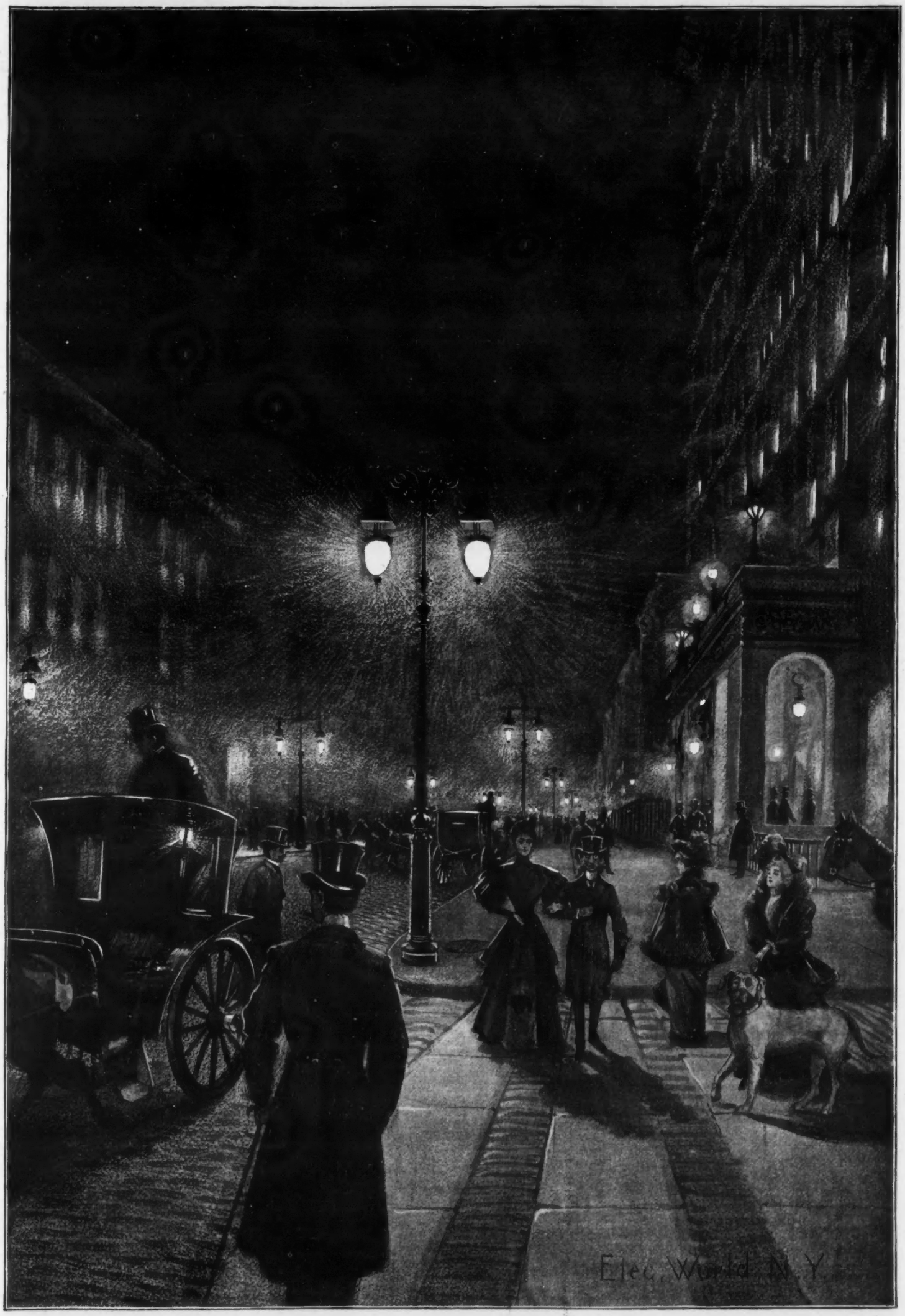
While electricians are trying to solve the problem of communication with a vessel by electrical means, others are apparently having great success with a very simple acoustic apparatus consisting of an ordinary bell as a transmitter and a metallic diaphragm as a receiver; the two must be tuned to the same note, in which case the water at a sufficient depth will transmit the Morse signals quite readily.

## The Lighting of New York's Greatest Avenue.

About a year and a half ago the low tension system of street lighting was introduced for the first time in New York on Fifth avenue. It had been found that some such device must be resorted to, for series arc lamps were little demanded on that avenue for commercial purposes, and the expense of laying the wires for conduits for street lighting alone was so great as to be practically prohibitive. Accordingly the Edison Illuminating Company solved the difficulty very satisfactorily by employing a low tension system, in which a pair of arc lamps on each post were used instead of a single lamp with dead resistance, as had been the case in previous attempts at low tension arc lighting. Each of these lamps, which were of the Bergmann type, manufactured by the General Incandescent Arc Light Company, took five amperes at approximately 50 volts, so that practically the same amount of energy was used as in the high tension arc lamp on the series circuit. The low tension system also possessed a number of advantages over its older rival. In the first place it was possible to connect the lamps directly to the Edison low tension mains, thus effecting a great economy and adding to the convenience and flexibility of the system; secondly, the light was more effective on account of better diffusion, as the casting of shadows was practically obviated.

An ornamental post was employed made in three parts, the base, the shaft and the arm section. Instead of placing the resistance in the hood of the lamp, it was located in the base, and the lamps were lowered and raised from within the shaft, to which access was had by means of a door in the base, the key of which was carried by the trimmer. The lamps are fed by a sliding contact, so that when they are lowered the current is entirely shut off and the trimmer is perfectly safe from even a low tension shock. The lamps are supplied from the mains by the ordinary house service method, wires running through the gas pipe which forms the centre part of the shaft.

One of the great advantages of this system of lighting is the ornamental appearance of the posts and the lamps, which greatly surpass in this respect the older type of series lamp. This system has been found to operate most satisfactorily during the past eighteen months, and the only criticism passed upon it was that the avenue was not as brilliantly lighted as had been anticipated. The Edison company recently decided to overcome this difficulty by doubling the number of lamps, and accordingly have inserted at the centre of each block another post carrying two lamps. There are now 114 posts, which, with two lamps each, makes a total of 228 lamps. This has had the desired effect, and as may be seen from the illustration on the opposite page, Fifth avenue is one of the most brilliantly illuminated thoroughfares in the city. At the same time the light is much more soft and pleasing than that which is given by high tension lamps.




FIFTH AVENUE BY NIGHT.

## Laboratory Notes.—XVII.

BY LIEUT. F. JARVIS PATTEN.

Before leaving this subject, it seems worth while to inquire what the nature of the field will be when produced by two independent currents having quite different frequencies, one having a frequency that is some whole multiple of the frequency of the other, and the two acting as before in the same magnetic system along axes at right angles to each other.

The simplest case is that shown in Fig. 44, which indicates two currents, $x$ and $y$, the latter having just double the frequency of the first, and their zero periods occurring at the same instant. Dividing the time period $t_0$ to $t_1$, as before, into a convenient number of equal parts and plotting the intensities and directions of the resultant forces, we

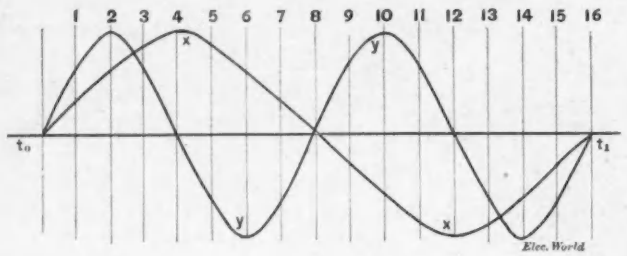



FIG. 44.

determine the points 1, 2, 3, etc., Fig. 45, of a singular curve that indicates clearly the action of the field with respect to the axes $X\,X$ and $Y\,Y$ during one complete period of the current of lower frequency $x\,x$, which cycle is constantly repeated. Here the field has some resemblance to a rotary

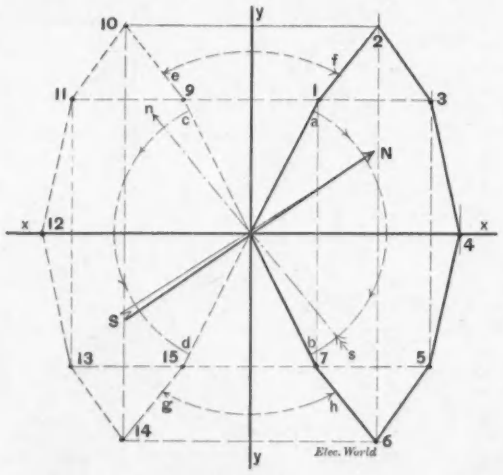



FIG. 45.

field, but reverses polarity at every half revolution and then goes backward; thus it swings through the arc $a$ to $b$ with the clock, and then reverses and swings over the arc $c$ to $d$ against the clock, making a field of reversing polarity, like a single alternating current, but one that also rotates through a part of the circumference. With sufficiently low frequencies such devices may find some use for synchronizing apparatus and serve to show what a variety of moving field can be obtained by combinations of two currents in a single system.

Figs. 46 and 47 show the effect of two currents, $x\,x$ and $y\,y$, that have frequencies of three to one, and Figs. 48 and 49 show the motion of the field when the currents have frequencies of two to three. The effect here is peculiar, as there is an almost complete rotation of the field, with the intensity varying comparatively little, as indicated by the full curve; then the direction of motion reverses and makes an almost complete revolution in the opposite direction, as shown by the dotted curve. Examining the two figures, we see that f the current indicated by the curve $y\,y$ is reversed at each half cycle, that is, at the time corresponding to the ordinate

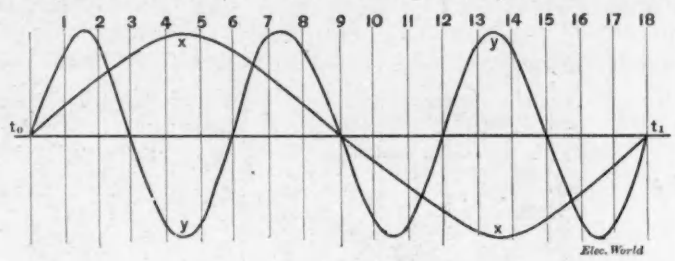



FIG. 46.

12, in Fig. 48, then the field due to the last half cycle would be identical with that due to the first half and a pulsating rotary field would result that describes nearly a complete revolution, and then jumping an arc of about 45 degrees, re-

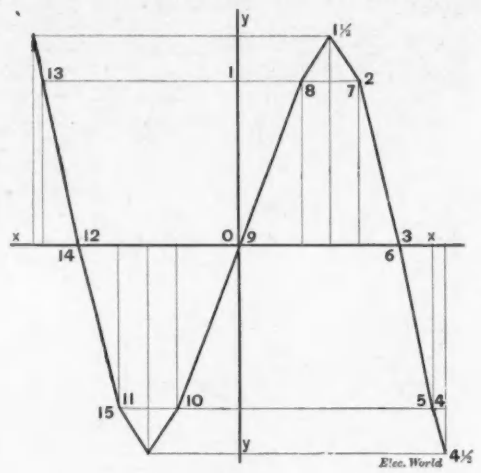



FIG. 47.

peats itself, which may be likened to rotary motion in which there is one dead point in a revolution instead of two or more, as is generally the case.

Though resorting to the rectification of such currents to obtain a desired effect is a little like begging the question, as we are then practically returning to the construction of a sort of direct current machine, it is none the less interesting to see what possibilities these different modifications will offer. We have thus far considered only the behavior of these currents of different frequency where both are applied to the same magnetic field or acting along different axes of the same magnetic system.

If one of them be applied to a ring field, as before, and the

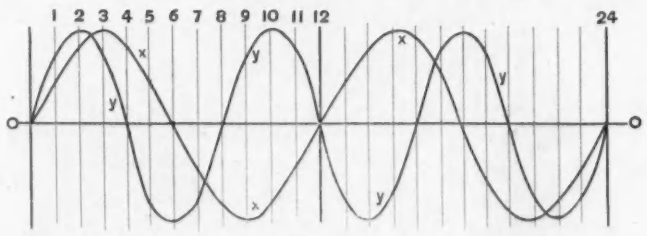



FIG. 48.

other to the revolving part, or armature, an entirely new set of combinations will arise.

As an illustration of this, take the two currents indicated in Fig. 49, having frequencies of one to three, and let the low frequency current $x\,x$ be introduced to the revolving part, or armature, and the one of higher frequency, $y\,y$, to the field, as indicated in the diagram, Fig. 50, which represents a ring field where the higher frequency current $y\,y$ enters at three equi-distant points, 120 degrees apart, and

leaves at three others intermediate between them, thus making a six-pole field.

The other current is introduced to the revolving part through a pair of brushes, and a two part commutator, as shown. The current in the field and the field poles will reverse three times to one reversal of the armature, and if the current in the latter is rectified at each half revolution, continuous rotation will ensue in this system by the rectification of the current of slow period only. Thus, suppose the armature with a north polarity, as indicated by the arrow pointing to the left, it will tend to leave this position and go one way or the other toward a south pole; suppose that motion ensues clockwise, then when the armature reaches the next pole of the field it will have changed to north, and




FIG. 49.

motion will continue because the armature has not changed its polarity; the same thing will happen at the next pole, the field poles changing as the armature approaches them continues the movement in the same direction until three poles have been passed, when the armature would reverse direction, owing to reversal of its current, but at this point




FIG. 50.

the commutator rectifies the armature current for the next half revolution and motion continues in the same direction.

A machine can be made operative, however, with currents of different frequencies in the fixed and moving parts without the aid of commutator or any rectifying devices. Take, for instance, the two currents indicated in Fig. 44, having periods of two to one, and let the current $x\,x$ of lower frequency be supplied to a ring field at the extremities of a given diameter, while the other is supplied to the armature $A_1$ of the machine, shown in the diagram in Fig. 51, in four successive positions, *a*, *b*, *c*, *d*, of a single revolution.

In the starting position, 51*a*, the polarities are as indicated, and motion will be clockwise. When, however, the armature has turned a quarter revolution, as in position *b*, its current begins to change, and there is repulsion at both poles of the field in the same direction as the former attraction. When another quarter revolution is completed, as at *c*, both field and armature simultaneously change polarity in such a way as to continue the motion by attraction at both poles, and by change of the armature current after another quarter, while the fields still remain the same, repulsion again takes place for another quarter, thus completing the cycle, and motion continues this way, if the machine can once be started, which operation is attended with the difficulties common to a single phase machine, which it is in one sense of the word, as there are two dead points in each cycle, or single revolution.

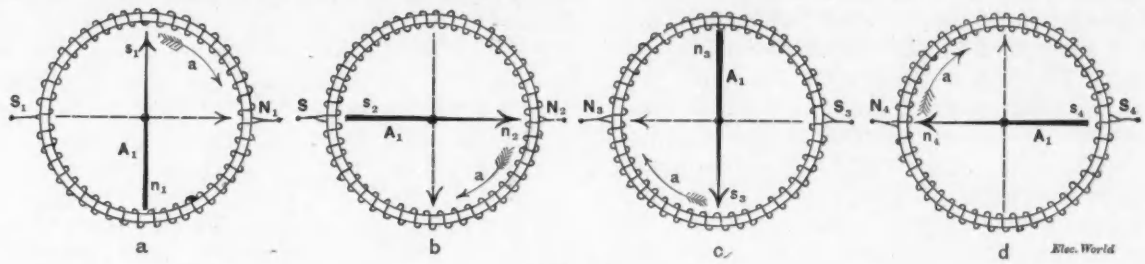



FIG. 51.

By using an auxiliary device, however, this machine can be made self-starting. The plan hardly requires illustration. Another ring field is supplied by two circuits at right angles to each other; in one of these the field current is introduced as before, and in the other a transformed current that is derived from the first in such a way as to produce a slight rotary field effect, which acts upon an independent closed circuited armature secured to the same spindle as the other. The effect of this second armature being always in the same direction, will start the first and bring it to synchronism, when the starting device can be dispensed with.

(To be continued.)

## On Parallel Working with Special Reference to Long Lines.*

BY W. M. MORDEY.

In his reply at the end of the discussion on his Niagara paper, Prof. Forbes alluded to some experiments which he had witnessed, and which he considered showed that alternators of my design would not run properly in parallel. The passage is as follows: "At the time when I recommended the Mordey machine I said that, before deciding to adopt it, tests must be made with a resistance between the dynamos in parallel. Does Mr. Mordey forget that, when he kindly placed at my disposal the means of making this test, by putting 'sunbeam' lamps in series—that is to say, between the two dynamos working in parallel—the lamps went up and down in brightness with the periodicity of a few seconds, and that the tendency was to rise to maximum brilliancy, showing that the dynamos were rather working in series than in parallel? From the moment of those experiments, I felt that that type of machine was not suited for our purposes, though I never mentioned that until I was compelled to by Mr. Mordey's claims for his special mode of working." I heard his remarks with the utmost astonishment, as the experiments, rightly interpreted, appeared to afford the very strongest proof of the exceedingly powerful synchronizing

* Extract from a paper presented to the London Institute of Electrical Engineers.

effort exerted by these machines, and because I then heard a contrary view expressed for the first time. And in another passage Prof. Forbes stated that they must have alternators at Niagara that will run without any synchronizing or waste current.

The matter is of some moment, and demands an explanation. With your permission, I will make this explanation the text and starting point of a paper on parallel working, and on the allied subject of the use of alternators as synchronous motors. The experiments were made in July, 1891, and were mentioned in the "Electrical Review" and elsewhere, in each case as having afforded an illustration of the thoroughly satisfactory parallel working of alternators when directly coupled to high speed engines—a matter with regard to which there was at that time some uncertainty. It had been supposed that some flexible or yielding coupling was necessary between the engine and alternator. For my own part, I never had any doubt on the subject; but in order to place the matter beyond dispute, some tests were carried out by the Brush Electrical Engineering Company and Messrs. Willans and Robinson. The former provided two of my alternators, the latter fitted them to two Willans engines. Among others, Prof. Forbes received an invitation to witness the trial, and was present.

When all the tests of ordinary parallel working had been satisfactorily carried out—including shutting the steam off the engine driving one of the alternators, and then applying a brake to its flywheel in a vain attempt to force it out of step—a further test was made (as an interesting experiment bearing on the subject of synchronous motors) to ascertain what would occur if the two alternators were coupled together with a resistance between them so great that the resistance alone would be sufficient to absorb the whole power of one machine, even if the machine at the other end were at rest; and the remarkable fact was established that even under these conditions (which would be absolutely absurd or impossible in practice) the two machines did not break out of step. The resistance used consisted of "sunbeam" lamps, which happened to be the only suitable resistance available. These lamps, being made for 80 volts and about 5 amperes, would have a resistance, hot, of about 20 ohms each, and a much higher resistance when cold—probably more than 30 ohms. Seven of these lamps were placed in series between the alternators. There was no other external circuit. It was then found that there was a current passing through them which rose and fell with a slow pulsation; the alternators, although not actually breaking out of step, evidently getting a good deal out of true co-phasal synchronism, and only being pulled in when this slowly pulsating current rose to a considerable amount. Synchronism being regained, the current decreased again. This current was not measured, but was probably about seven amperes, as the lamps were a good deal over incandesced. The experiment was then discontinued. Properly interpreted, this test appeared to show that even when a line of an enormously high resistance was interposed between two alternators arranged to run in parallel (or one as generator, the other as synchronous motor), and when no adjustments were made to help them to keep together, the tendency to get out of step was corrected with a surprising amount of success, the correction, instead of being instantaneous and powerful, as with machines connected through a small resistance only, being sluggish, and greatly weakened by the very high resistance of the line.

To show how utterly unfair and unjust Prof. Forbes' interpretation is, and to reassure those who may desire to use synchronous motors, it is only necessary briefly to examine the conditions of the test. The two alternators used in the experiment were 37.5-kw. 2,000-volt machines. At full load each would therefore give nearly 20 amperes. Now, suppose it is desired to run one machine as a generator, driving the other as a synchronous motor (to take the illustration that may best suit the case of power transmission over a considerable distance), it will be seen that if the line is to be designed to give such a percentage loss as is proposed for the Niagara-Buffalo transmission—that is, 3.5 per cent.—the loss at full load should be 70 volts, and the maximum current being, say, 20 amperes, the line resistance should be 3.5 ohms. In the actual experiment, the machines did not break out of step even when the line resistance was more than 100 ohms—that is, relatively more than 30 times greater than Prof. Forbes proposes to use even for his long distance transmission. This is the more striking as a proof of their powerful synchronizing when it is considered that even if it had been intended to expend the whole power of the generator in the line, that line should only have had a resistance of 100 ohms. That these machines did not act quite perfectly in parallel under these conditions, even with no load, is not to be wondered at. The only cause for surprise is that they exerted any sensible synchronizing effort at all. It is exactly as if an attempt had been made to run two 1,200-kw. alternators in parallel through a line constructed to allow a reasonable loss for a couple of 40-kw. machines. Even unloaded, such a test would be unreasonable. * * * *

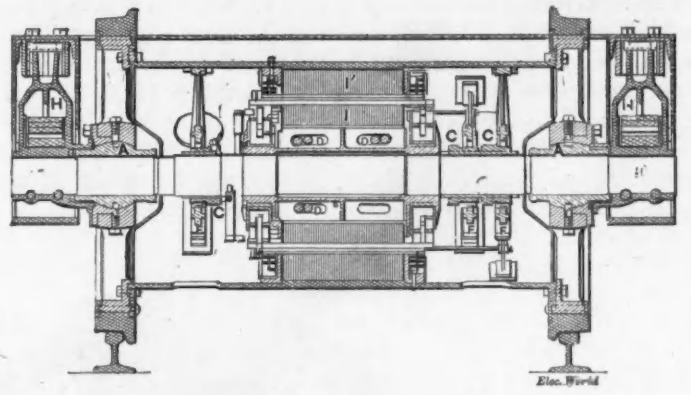
The condition of entire absence of synchronizing current or of correction can only be obtained by driving by engines that are very even in power always. I think this is more likely to be approached by turbines than by reciprocating engines. By "synchronizing current" I do not mean necessarily an actual current passing from one alternator to the other—this only occurs when one of them is driven as a motor—I mean the variations of the current contributed by each machine to the circuit. But I would like to point out that the condition laid down by Prof. Forbes as an essential—namely, that they must have alternators at Niagara that will run without any synchronizing or waste current—is an absolute impossibility. Alternators will run without synchronizing current only when there is no necessity for them to exert any synchronizing effort. However, I am glad to find that Prof. Forbes has set himself to solve this problem of getting an alternator motor to run without any current (for that is what it amounts to), because I am sure that in solving it he will also have disposed forever of that other interesting problem—making a motor that will run without any back E. M. F. This is a new and significant outcrop of the "perpetual motion" idea.

I am sure that if Prof. Forbes had really considered or understood this matter he would not have expressed the opinion which I have quoted. At the same time, I wish to say I am convinced that his criticism was not unfair by intention. At the end of the passage quoted from Prof. Forbes, it will be seen that he states that he had never mentioned the matter until compelled to do so by some claims of mine for a special mode of working. I do not know what claims are referred to, nor do I know what compulsion he was under; but I do know that in making these statements publicly, without first mentioning the matter to me or to some of my colleagues and giving us an opportunity of expressing our views or giving an explanation, he exhibited a want of courtesy and of ordinary consideration which I venture to think quite exceptional. In the frequent friendly conversations which I have had with him there have been ample opportunities for the discussion of such matters. No doubt he had a right to advise his company as he thought proper; but I maintain that, without the very fullest justification for his statements, he had not a right to come to this Institution, and in the most public manner utter charges seriously affecting the character and capabilities of a trading company's manufactures. I submit that in his strictures on the synchronizing power of my alternators he was absolutely without such justification.

### The Heilmann Electric Locomotive.

The Heilmann electric locomotive, which was tried in January on the Havre section of the Chemin de Fer de l'Ouest in France, is a wide departure from the usual methods of electric traction, and at first sight seems to rather mark a retrograde movement than an advance. The system consists of a locomotive which carries a boiler and engine to furnish power to an electric generator, which supplies current to gearless motors on the eight axles of the locomotive.

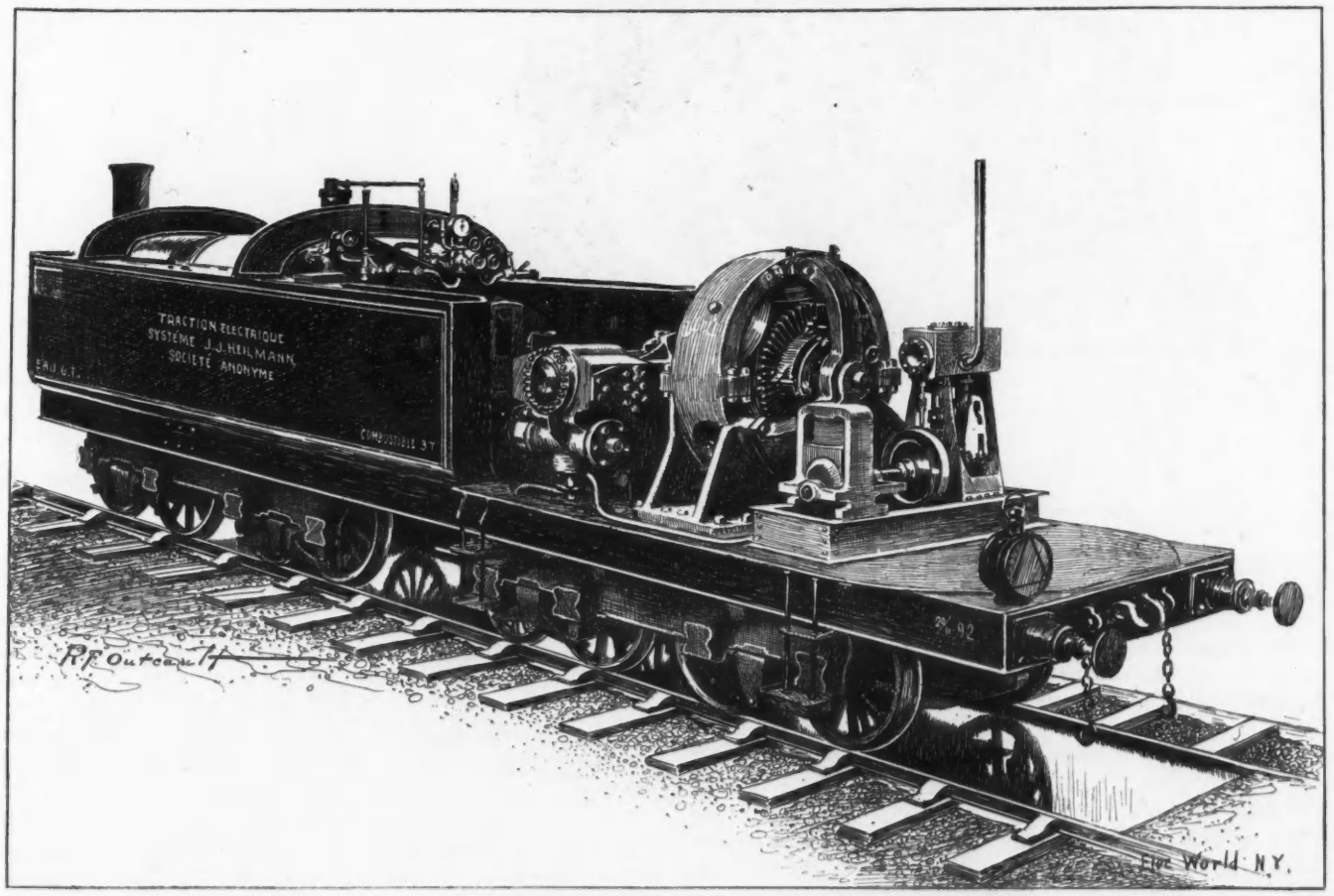
It is claimed that by this method of driving a greater stability or smoothness over the steam locomotive is attained at high speeds, due to the smaller wheels that can be used at a greater number of revolutions and the absence of oscillations. The adherence and flexibility are greater, as a greater weight can be distributed and in a more advantageous manner with sixteen wheels than with four, to which the steam locomotive is limited in order to possess sufficient flexibility to round curves. The boiler capacity in the new system can be made much larger, and by the use of economical engines power can be supplied more cheaply even at the points of final application than with wasteful locomotive engines. Accessory advantages claimed are that all parts of the machinery requiring attention are readily accessible and as directly under the eye of the attendant as the machinery of a steamship; the analogy is further carried out by the fire room and machinery being entirely separated. The lubrication is more efficient and easily attended to, and the track is subjected to lighter wear on account of the absence of the "pounding" incident to the use of steam locomotives.




MOTOR OF HEILMANN LOCOMOTIVE.

The locomotive is 52 feet long between buffers, and supported by two trucks with four axles each, with an electric motor on each axle; the entire weight is 110 tons.

The boiler is of the marine locomotive type with a corrugated furnace. It is 26 feet in length and somewhat over 6 feet in diameter, with 1,550 square feet of heating surface; the pressure is 160 pounds. A coal bunker and water tank of 6 and 10 tons capacity respectively are placed on each side of the boiler. The engine is of the compound type, the high and low pressure cylinders being on opposite sides of the cranks, which are at an angle of 180 degrees. Its weight is 11,000 pounds, or 20 pounds per effective horse power. The consumption of steam is 23 pounds per horse power hour.



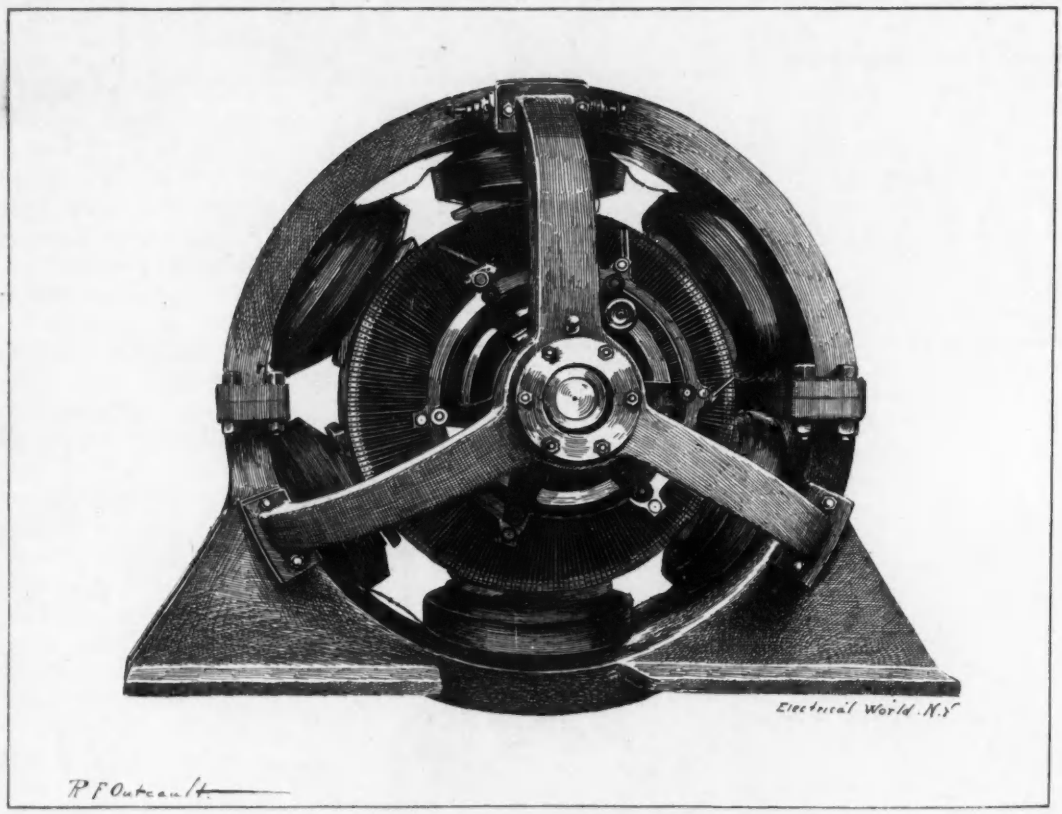

HEILMANN ELECTRIC LOCOMOTIVE.

The engine is direct connected to a 6-pole ring armature, continuous current dynamo, which is so wound as to work with three, two or even one pair of carbon brushes. The external diameter of the frame is 79 inches and of the armature 49 inches. The dynamo is separately excited by a compound dynamo run by a small engine, and with 360 revolutions produces an available horse power of 600, with a maximum horse power of 800 with 800 revolutions. If the dynamo stops at one of the engine dead point, the exciter is connected to the armature for an instant, which causes the former to work as a motor and carry the engine beyond the dead point.

The motors have four poles and steel frames cast in a

single piece. The toothed armature is 25 inches in diameter, with a large air gap to reduce eddy currents. It is mounted on a steel tube, supporting the whole weight, which is fitted on the axle with a bushing of woodite, an elastic insulating material impervious to oil. The steel tube terminates at one of its extremities in an elastic coupling, which prevents jerking in starting. The eight motors form two groups, each comprising four motors coupled in parallel. In starting the two groups are connected in series and then in parallel after a certain speed has been attained.

At the trials in January a load of 90 tons was hauled up gradients of 3 and 8 in 1,000 respectively at a speed of 5c




GENERATOR OF HEILMANN LOCOMOTIVE.

miles per hour in the former case and 35 miles in the latter, the train being in regular duty for several days.

## A Modified Instrument for the Determination of the ℬ ℋ Curves of Iron.

BY H. W. SCHROEDER.

An article on this subject, which appeared in The Electrical World of Feb. 24, 1894, called to my mind a very simple method invented by myself some time ago for measuring the relative permeability of different grades of iron.

I use a soft ∪-shaped yoke, between the legs of which is placed the piece of metal to be tested and around which is wrapped the exciting coil. At the curved end of the yoke is placed a coil which is connected to a voltmeter reading from 1 to 100 volts.

In fact, my instrument may be looked upon as a simple transformer from which the primary core may be removed and replaced by the cores to be tested.

We will treat it as such, and will call the coil surrounding the removable core the primary and the coil at the bent end of the yoke, with which the voltmeter is connected, the secondary.

Now, it follows that if a piece of iron, the permeability of which is high, be placed between the legs of the yoke and used as a primary core, and an exciting current sent through the primary coil surrounding this, there will be a current induced in the secondary coil; and if this exciting current be increased until the voltmeter indicates 100 volts and be maintained constant, we can then replace our high permeability core with one we desire to test.

All the conditions now being the same as at first, except the primary core which we are testing, the voltmeter in the secondary will indicate in proportion to the number of lines of force cutting the secondary coil. The number of these lines of force depends upon the permeability of the metal being tested, and if the voltmeter now indicates but 75 volts we may know that the permeability of that piece of iron is but 75 per cent. of that of the first.

Such an instrument as this is very easily constructed, the only part not readily at hand in almost any workshop or laboratory being a standard bar to compare with, but even this is not necessary where it is only wanted to determine the best of a few samples of iron.

Of course it is understood that an alternating current is used as an exciting current, and that any alternating current voltmeter will do for use in the secondary.

I might add that where it would be inconvenient to maintain a uniform exciting current, two of these instruments (just alike) could be used, one for the standard bar and one for the iron to be tested, the primaries being connected in series, thus taking the same current. Two voltmeters would be used, one in each secondary, and compared directly with each other.

For further accuracy the standard to be tested could be changed from one instrument to the other and the voltmeters compared again.

## An Unpatented Improvement in the Magneto Telephone.

BY C. E. GIFFORD.

Now that the fundamental Bell patents on the magneto telephone have expired, the writer desires to give to the public an idea developed by him fifteen years ago.

This idea was simply the application of a closed secondary circuit of low resistance to the exterior surface of the coil of a magneto telephone for the purpose of overcoming self-induction. The principle involved has become familiar from the study of the alternating transformer, etc., but so far as the writer's observation extends it has not been applied to the telephone by others.

Perhaps some mathematician of the class that are wise in their own conceit but not in reality will proceed to show a heavy absorption of energy by this closed secondary. Let him remember that clearness of articulation is the great desideratum in a telephone, and that self-induction is the arch enemy of such distinctiveness. Practically, the loudness of the telephone will not be found in any manner impaired (the writer has found it to be rather the opposite), and the improvement in definition is very marked, especially in case magneto instruments are used both in transmitting and receiving.

A close fitting, thin metal case of any non-magnetic metal (non-magnetic that it may not deflect the magnetic lines in an undesirable manner) in the form of an inverted flat-bottomed cup with the bottom perforated for the projection of the core of the coil, will, when slipped over said coil and properly secured, be found to answer the purpose admirably.

The case may be suitably made of copper or brass, with soldered joints, and may be supplemented by a disc of the same or other suitable metal placed beneath the coil. Cheaper makeshifts of tinfoil, separated from the coil by paper, may be made, but are hardly advisable.

On lines using several instruments in series, the articulation would be improved by also sheathing the coils of the call bells.

Where instruments are "bridged on" or used in multiple, nothing but the coils of the receivers should be sheathed, and battery transmitters should be arranged to shunt by pressing a button, as is now customary.

Condensers properly adjusted and properly used may also serve the same purpose, but the simplification of the above arrangement makes it far preferable.

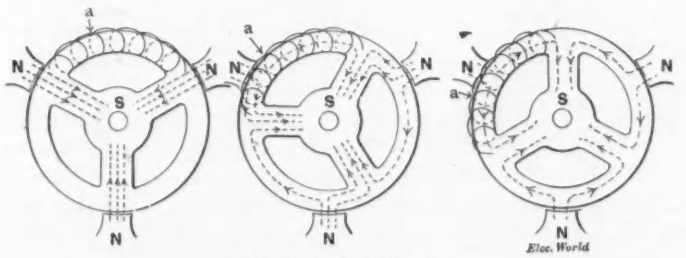
When this arrangement was first used by the writer, the iron grip of the monopoly robbed telephone patents other than their own of any peculiar attractions, so the matter was kept quiet. It might be well for the public to benefit by the above, if they care to, before some bright, "original" inventor tries to lock it up with a "fundamental" patent.

## Inoperative Unipolar Machines.

BY G. M. WARNER.

I have noticed several articles recently discussing the probable effect on the magnetic field of rotating either the iron core or the exciting coil, and whether in such cases the so-called lines of force follow the movement of the core or the coil. Many of the cases cited are of interest, though none seem to me to bear directly on the subject, neither proving nor disproving the question in dispute, as all have a rotating spider form tending to bring in various complications.

Take, for instance, Mr. Ford's machine, described in the issue of Feb. 24, the essential features of which I have em-




FIGS 1, 2 AND 3.

bodied in Figs. 1, 2 and 3, using less pole pieces to save complication. The stationary poles, *N*, are all of one polarity, the opposite pole being at the centre or hub. The rotating armature is shown in three successive positions one-twelfth of a revolution apart.

The idea was that the lines leaving the poles, *N*, and entering the armature, cutting the winding, would complete the circuit to the opposite pole by the spokes only, following them in their rotation, thus avoiding the cutting of the winding in leaving the rim.

The failure of the machine to generate any voltage that would affect any direct current instrument was taken as a proof of the falsity of the assumption, but this does not necessarily follow, for granting the assumption to be true, as I surely do, there is still a good and sufficient reason for the experiment resulting as it did.

I know the general public has a sort of mistrust in mathematical proofs of any kind, so in the following I will confine myself as closely as possible to graphical constructions, first calling especial attention to the law of magnetic circuits, "The strength of the magnetic field equals the magnetomotive force divided by the magnetic resistance."

When we have several paths by which the lines can reach the opposite pole, as in Figs. 2 and 3, by the spokes or across the air space, the number in each path would be inversely as its magnetic resistance. The resistance of air being hundreds of times as great as iron, only an inappreciable amount would leak across this way. The dotted lines in Figs. 1, 2 and 3, representing the lines of force, the arrow heads giving the direction, are drawn on this basis and the particular point to be noticed is the direction in which they thread through the coil *a* in different positions of the armature, viz.: first, in neither direction; second, right-handed; third, left-handed; one-twelfth of a revolution further on it would still be left-handed and one-twelfth further on as in Fig. 1 again. From this we might infer that an alternating voltage could be obtained from the terminals, and part of his experiment seems to bear this out.

There is some tendency in a machine of this character to generate an opposing E. M. F., due to the changing length of magnetic circuit, depending on the relative dimensions and amount of winding, but I do not wish to take space to discuss this, for in all probability the machine in question generated voltage enough to be measured by proper instruments, or these not being at hand, some difference ought to be noticed in the power required to drive it on open circuit and absolute short circuit.

## The Underground Trolley in New York.

The Metropolitan Traction Company, it is stated, is now considering a proposition from Siemens & Halske for the installation of an underground system similar to that which has been in use at Budapest for some time, that firm offering to equip the Twenty-third street cross-town line at its own expense. It is also stated that the proposition will probably be accepted, but not without a strong effort on the part of the General Electric and Westinghouse companies to defeat their foreign rival.

The system, if adopted, will be used only on those lines where the traffic is not heavy enough to warrant the expense of a cable. The Belt Line is said to be one on which it can be advantageously applied, as the route travelled is thirteen miles long, and the company has only one stable. The horses, therefore, are worked very hard, especially as there is heavy traffic in the downtown portions of the route, which necessitates frequent stoppages and delay.

This system was fully described in The Electrical World of Oct. 24, 1891.

## An Alleged Anticipation of Bell.

It is reported that an English officer, named Harrington, has discovered in India a working telephone between the two temples of Pauj about a mile apart. The system is said to have been in operation at Pauj for over 2,000 years. In this connection we may observe that Egyptologists have found unmistakable evidence of wire communications between some of the temples of the earlier Egyptian dynasties; but whether these served a telegraphic, telephonic or other purpose is not stated.

## Honors to a Delegate to the Chicago Congress.

Dr. Emil Budde, of the firm of Siemens & Halske, Berlin, has received the honorary title of Professor, in recognition of his services as a delegate of the Imperial German Government to the late Chicago Electrical Congress.

## Rope Driving.—X.*

BY J. J. FLATHER.

From these assumptions the following tables of the values of $1 - s$ have been computed :

TABLE IV.—VALUES OF $1 - s$ FOR A WORKING STRESS EQUIVALENT TO $200\ d^2$ POUNDS.

| Velocity in feet per minute. | Values of $1 - s$. | Velocity in feet per minute. | Values of $1 - s$. |
|---|---|---|---|
| 1000 | 0.98 | 5500 | 0.58 |
| 2000 | .94 | 6000 | .50 |
| 2500 | .91 | 6500 | .41 |
| 3000 | .87 | 7000 | .32 |
| 3500 | .83 | 7500 | .22 |
| 4000 | .78 | 8000 | .11 |
| 4500 | .72 | 8500 | .0 |
| 5000 | .65 | | |

It will be seen from the above that when the velocity of the rope is as great as 8,500 feet per minute, $1 - s = 0$, hence log. $r = 0$ and $\frac{T_1}{T_2} = 1$; that is, $T_1 - T_2 = 0$, and, therefore, no power will be transmitted unless the assumed working tension, $t$, be exceeded.

In average work the lesser arc of contact embraced by the rope—generally on the smaller pulley—will be about 165°, and this value may be assumed for approximate calculations with a working degree of accuracy. If the angle in degrees is known, its value, $\alpha$, in circular measure, can be obtained from Table V., in which $\alpha = 0.0175\ \alpha^\circ$.

TABLE V.—ANGLE EMBRACED BY ROPE.

| Degrees, $\alpha^\circ$. | Circular measure, $\alpha$. | Fraction of Circumference, $\frac{\alpha^\circ}{360}$. |
|---|---|---|
| 105 | 1.83 | 0.29 |
| 120 | 2.09 | .33 |
| 135 | 2.35 | .37 |
| 150 | 2.62 | .42 |
| 165 | 2.88 | .46 |
| 180 | 3.14 | .50 |
| 195 | 3.43 | .54 |
| 210 | 3.66 | .58 |
| 240 | 4.19 | .66 |

If we now assume the coefficient of friction $\Phi$ to be 0.31 for a 45° groove, we may obtain the value of the expressions

$$T_1 = \varepsilon^{\Phi\,\alpha_1^\circ(1-s)} = r,$$

and

$$\frac{T_1}{P} = \frac{r}{r-1}.$$

In order to simplify calculation, the following table (VI.) contains values of $r$ and $\frac{r}{r-1}$, which will enable the horse power transmitted by a rope to be determined with a degree of accuracy depending upon the assumption of the coefficient of friction:

TABLE VI.—FRICTION AND STRESS MODULI.

| $\Phi\,\alpha\,(1-f)$ | $r = \frac{T_1}{T_2}$ | $\frac{r}{r-1} = \frac{T_1}{P}$ |
|---|---|---|
| 0.1 | 1.11 | 10.41 |
| 0.2 | 1.23 | 5.40 |
| 0.3 | 1.35 | 3.86 |
| 0.4 | 1.49 | 3.02 |
| 0.5 | 1.65 | 2.54 |
| 0.6 | 1.82 | 2.22 |
| 0.7 | 2.01 | 1.99 |
| 0.8 | 2.22 | 1.82 |
| 0.9 | 2.46 | 1.69 |
| 1.0 | 2.72 | 1.58 |
| 1.1 | 3.00 | 1.50 |
| 1.2 | 3.32 | 1.43 |
| 1.3 | 3.67 | 1.37 |
| 1.4 | 4.06 | 1.33 |
| 1.5 | 4.48 | 1.29 |

The following application will show the use of the tables. Let it be required to determine the horse power transmitted by a rope 1 inch in diameter running at a velocity of 4,000 feet per minute over a pulley with 45° grooves. Assuming an arc of contact of 165°, we find from Table V. $\alpha = 2.88$; for the required velocity, 4,000 feet per minute, Table IV. gives 0.78 as the value of $1 - s$; therefore assuming the coefficient of friction $\Phi = .31$, we obtain

$$\Phi\,\alpha\,(1-s) = 0.31 \times 2.88 \times .78 = .69.$$

From Table VI. the value of $\frac{T_1}{P}$, corresponding to 0.69, is about 1.99, and as $T_1 = 200\ d^2 = 200$ pounds in the present case, we find $P = \frac{T_1}{1.99} = 100$ pounds; since $\frac{P\,V}{33000}$ = h. p., there is obtained h. p. $= \frac{100 \times 4000}{33000} = 12.15$, represented by the ordinate $l\,m$ in Fig. 30.

The loss due to centrifugal force may now be obtained by assuming the latter reduced to zero, in which case the factor $1 - s$ is equal to unity; therefore log. $r = .434\ \Phi\,\alpha$, from which, with the previous conditions, we obtain $P = 120$ and the corresponding h. p. $= 14.5$.

This value is represented on the diagram, Fig. 30, by the

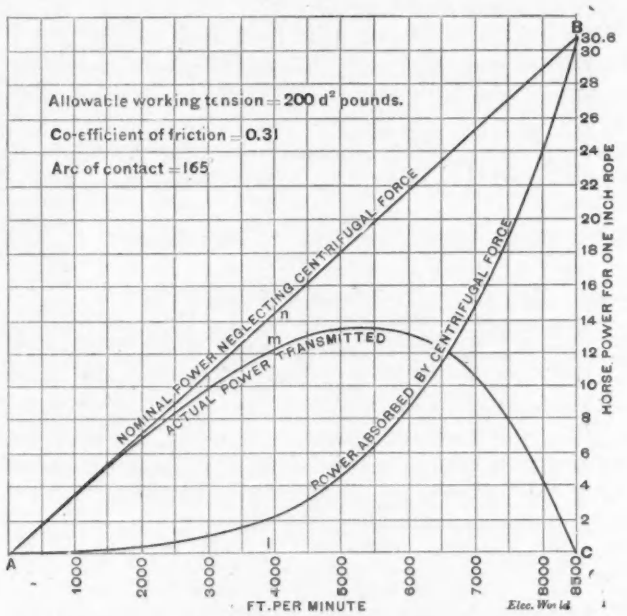



FIG. 30.—CENTRIFUGAL EFFECTS IN ROPES.

ordinate $l\,n$; the difference between $l\,n$ and $l\,m = m\,n$ will then be the loss due to the centrifugal force set up in the rope = 14.5 — 12.15 = 2.35 horse power.

For any special case where the data are known or may be determined, the formulas and tables already given should be used to ascertain the horse power transmitted, or diameter and number of ropes required for a certain work, as the case may be. For average work, however, it will be found that the assumed values of $\alpha$ and $\Phi$, previously noted, will give very satisfactory results, and upon these assumptions the writer has computed the following table of horse power, for various sized ropes, running at varying speeds.

TABLE VII.—HORSE POWER TRANSMITTED BY ROPES. WORKING STRAIN = $200\ d^2$ POUNDS.

| Velocity of rope in feet per minute. | Diameter of Rope 5-8. | 3-4. | 1. | 1 1-4. | 1 1-2. | 1 3-4. | 2. |
|---|---|---|---|---|---|---|---|
| 1,000 | 1.24 | 2.25 | 3.57 | 5.59 | 8.02 | 10.85 | 14.20 |
| 2,000 | 2.70 | 3.84 | 6.84 | 10.68 | 15.39 | 20.93 | 27.36 |
| 2,500 | 3.30 | 4.71 | 8.38 | 13.10 | 18.86 | 25.66 | 33.54 |
| 3,000 | 3.83 | 5.46 | 9.80 | 15.39 | 21.87 | 29.74 | 38.88 |
| 3,500 | 4.30 | 6.23 | 11.09 | 17.33 | 24.94 | 34.03 | 44.35 |
| 4,000 | 4.74 | 6.83 | 12.15 | 18.98 | 27.33 | 37.17 | 48.59 |
| 4,500 | 5.01 | 7.24 | 12.89 | 20.15 | 29.00 | 39.45 | 51.57 |
| 5,000 | 5.20 | 7.47 | 13.29 | 20.76 | 29.89 | 40.65 | 53.15 |
| 5,500 | **5.29** | **7.60** | **13.53** | **21.14** | **30.43** | **41.39** | **54.11** |
| 6,000 | 5.08 | 7.32 | 13.10 | 20.36 | 29.32 | 39.77 | 52.12 |
| 6,500 | 4.74 | 6.83 | 12.13 | 19.00 | 27.34 | 37.21 | 48.63 |
| 7,000 | 4.12 | 5.93 | 10.54 | 16.47 | 23.72 | 32.26 | 42.18 |
| 7,500 | 3.25 | 4.67 | 8.32 | 13.00 | 18.73 | 25.42 | 33.23 |

The graphic representation of these values, Fig. 31, shows

* For last section of this article see The Electrical World of Feb. 24.

per cent. faster at the increased speed; therefore taking the life of the rope as well as the first cost into consideration, the relative cost to transmit a given horse power at the speeds the effect of centrifugal force in diminishing the power transmitted under an assumed working tension, and would indicate that with tensions of $200\ d^2$ pounds the speed should not exceed 5,500 feet per minute. The increasing effect and loss of power due to centrifugal force in the rope can also be seen in the diagram, Fig. 3c, which represents the horse power transmitted by an inch rope under an assumed constant tension of 200 pounds. The straight line *A B* shows the power which would be transmitted if centrifugal force were neglected, and is obtained by making $s = o$ in the general equation

$$\text{Log } r = 0.4343\ \Phi\ \alpha\ (1 - s);$$

the curve *A C* represents the power transmitted when centrifugal force is taken into account, and the curve *A B* shows the power absorbed by centrifugal force—this latter curve is obtained by subtracting the vertical ordinates between the straight line *A B* and the curve *A C*.

By a consideration of the diagram it will be seen that at speeds less than 2,000 feet per minute the power absorbed by centrifugal force is very small and may be neglected as far as practical results are concerned. Beyond this speed, however, the loss from this cause increases very rapidly, until, as previously shown, at a speed of about 8,500 feet per

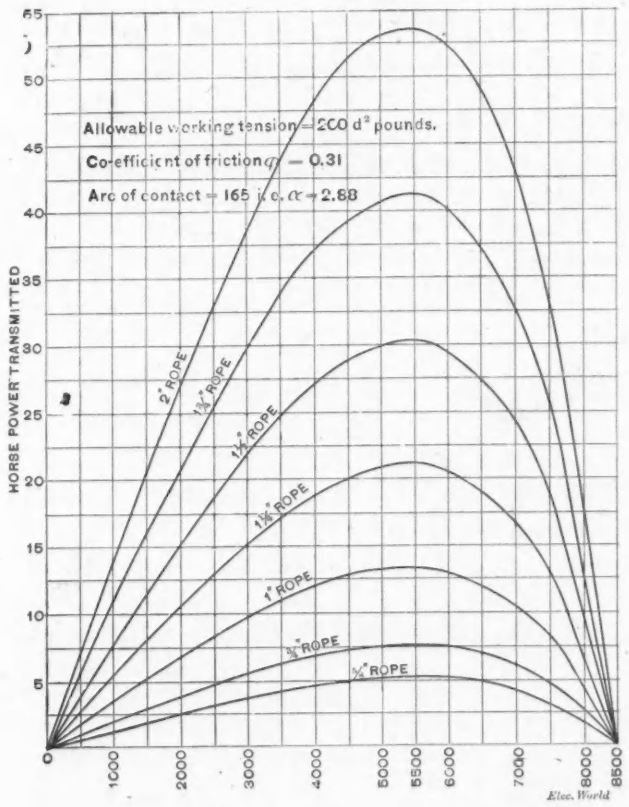



FIG. 31.—EFFECT OF CENTRIFUGAL FORCE.

minute, the whole of the allowable tension is absorbed. Assuming that the maximum power is transmitted by a rope at a velocity of about 5,500 feet per minute, it is evident that the first cost of the rope will be a minimum for a given power when running at this speed. The ratio of the first cost of the rope running at any other speed may be obtained by dividing the horse power at 5,500 feet per minute by the horse power at the required speed.*

Thus, if the first cost of an inch and quarter rope which will transmit 21.14 h. p. at 5,500 feet per minute be represented by unity, the cost at 3,000 feet per minute will be

$$\frac{21.14}{15.39} = 1.38,$$

since an inch and quarter rope running at 3,000 feet per minute will transmit 15.39 h. p.

The relative first cost for a given diameter of rope to transmit the same horse power at varying speeds is shown in the accompanying table:

TABLE VIII.—RELATIVE FIRST COST OF ROPE DRIVING.

| Velocity of rope in feet per minute. | Relative first cost per horse power. | Velocity of rope in feet per minute. | Relative first cost per horse power. |
|---|---|---|---|
| 1,000 | 3.78 | 4,500 | 1.05 |
| 2,000 | 1.89 | 5,000 | 1.02 |
| 2,500 | 1.62 | 5,500 | **1.00** |
| 3,000 | 1.38 | 6,000 | 1.03 |
| 3,500 | 1.22 | 6,500 | 1.12 |
| 4,000 | 1.10 | 7,000 | 1.28 |

Although the first cost of a rope to transmit a given horse power is a minimum for a speed of about 5,500 per minute, yet the economy is not as great as would appear from the foregoing table, for the effect of wear must be considered. The causes of wear, internal and external, have been previously discussed; it will be sufficient to note here that the internal destructive effect produced by bending and distorting the fibres and the wear due to external contact, slipping, or wedging in the grooves of the pulleys may within the limits of ordinary practice be considered as directly proportional to the velocity of the rope. What this wear is in terms of the velocity there is not sufficient data to determine, but if the coefficient be represented by *c*, the *relative* wear may be determined from *c v*, in which the wear increases directly with the velocity, but not, however, directly with the horse power transmitted.

If we assume the coefficient to be such that the wear on a rope at 1,000 feet per minute is equal to unity, then the wear on the same rope at any other speed will be:

$$\text{Relative wear} = \frac{\text{Required speed}}{1,000}.$$

To determine the relative wear per horse power transmitted by a given rope at varying speeds, it will be necessary to determine the wear per horse power for the rope running at any required speed, and then divide this value by the wear per horse power when running at 1,000 feet per minute. Let it be required to determine the wear of a rope transmitting a given horse power at 5,500 feet per minute, as compared to what it would be at 1,000 feet per minute.

The horse power transmitted at 1,000 feet per minute is found to be 3.57 for a one-inch rope, at which speed we have assumed that the wear is equal to unity, hence the wear per horse power may be considered equal to

$$\frac{1}{3.57} = .28.$$

At a speed of 5,500 feet per minute the horse power transmitted by the same rope is 13.53, but the wear at this speed is assumed to be five and a half times greater than at 1,000 feet, other conditions being the same, therefore the wear per horse power $= \frac{5.5}{13.53} = .406$; that is, the wear of any rope transmitting 1 h. p. at 5,500 feet per minute is $\frac{.406}{.28} = 1.45$ times the wear which would occur at 1,000 feet per minute.

From this it will be seen that although the first cost of a rope is cheaper at the higher speeds, the rope lasts longer while running at the slower speeds—conditions remaining constant.

Taking the case we have been considering, it is found that the relative first cost of the rope is inversely as the horse power transmitted or

$$\frac{\text{Cost of rope at 1,000 feet}}{\text{Cost of rope at 5,500 feet}} = \frac{13.53}{3.57} = 3.78,$$

that is, the first cost is 3.78 times greater for the slower speed, but it is shown above that the rope will wear out nearly 50

*C. N. Hunt, in Trans. A. S. M. E., vol. XII.

noted will be $\frac{3.78}{1.45} = 2.6$ times greater for the slower speed. This can be determined more conveniently by assuming $H$ = horse power transmitted at $V$ feet per minute. $H_1$ = horse power transmitted at $V_1$ feet per minute where $H_1 > H$ and $V_1 > V$. The wear per horse power in each case will then be $\frac{V}{H}$ and $\frac{V_1}{H_1}$; the relative first cost of the rope per horse power running at the lesser speed, compared to that when running at the greater, will be as $H_1$ is to $H$; hence the ratio of relative cost, taking wear into account, is

$$\frac{H_1}{H} \times \frac{\frac{V}{H}}{\frac{V_1}{H_1}} = \left(\frac{H_1}{H}\right)^2 \times \frac{V}{V_1}$$

TABLE IX.—RELATIVE WEAR AND COST OF ROPE PER HORSE POWER TRANSMITTED.

| Velocity in feet per minute. | Relative wear per horse power transmitted. | Relative cost of rope per H. P. transmitted considering wear. |
|---|---|---|
| 1,000 | 1. | 1 |
| 2,000 | 1.03 | .54 |
| 2,500 | 1.06 | .45 |
| 3,000 | 1.10 | .40 |
| 3,500 | 1.13 | .36 |
| 4,000 | 1.18 | .347 |
| 4,500 | 1.25 | .345 |
| 5,000 | 1.34 | .36 |
| 5,500 | 1.45 | .38 |
| 6,000 | 1.64 | .44 |
| 6,500 | 1.93 | .52 |
| 7,000 | 2.40 | .80 |
| 7,500 | 3.22 | 1.36 |

Table IX. has been calculated upon the above basis of comparison, namely, that the wear in a rope at 1,000 feet per minute is equal to unity and increases directly as the speed; and also that the cost of ropes for a permanent installation is proportional to the square of the ratio of the power transmitted at different speeds multiplied by the inverse ratio of the corresponding speeds. To ascertain the relative wear per horse power of a rope running at any given speeds, it will only be necessary to form a ratio between the values in the table corresponding to the given speeds. Thus, the wear per horse power at 5,000 feet per minute, as compared to that at 2,500 feet, will be $\frac{1.34}{1.06} = 1.26$.

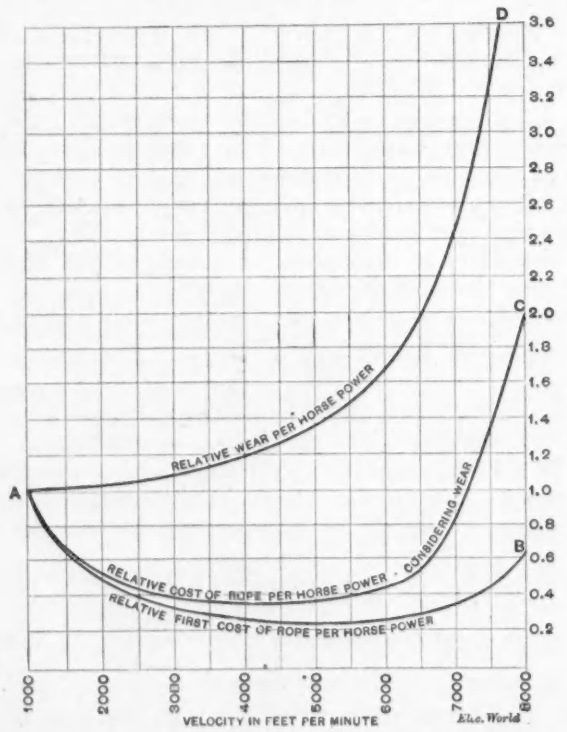



FIG. 32.—RELATIVE WEAR AND COST OF ROPE PER H. P.

In the same way the relative cost per horse power of a rope running at these speeds will be $\frac{.36}{.45} = 0.8$; or 20 per cent. less for the greater speed. The accompanying diagram, Fig. 32, represents these relative values graphically, to which is added the curve of relative first cost. It will be noticed that although the first cost of a rope is a minimum for a speed of 5,500 feet per minute, when wear is considered the minimum cost occurs at a speed of 4,500 feet per minute.

(To be continued.)

## The Calculation of Alternating Current Motors.—VII.

BY E. ARNOLD.

### THE BEHAVIOR OF A MULTIPHASE MOTOR WHEN THE ARMATURE IS IN MOTION.

THE armature is supposed to turn with an angular velocity $p_2$, when the difference between the angular velocities of the primary field and the armature (or the amount of slip) is

$$= p_1 - p_2.$$

We now refer again to Fig. 9 and the general equation (49) applicable to a rotary field, which reads

$$E_1^2 = \left[R_1 I_1 + \frac{s_2}{2} p_1 M I_2 \cos \Phi_2\right] + \left[\frac{m}{2} p_1 L_1 I_1 - \frac{s_2}{2} p_1 M I_2 \sin \Phi_2\right]^2.$$

The E. M. F. induced in one phase of the armature is now

$$E_2 = \frac{m}{2} (p_1 - p_2) M I_1.$$

This induced E. M. F. is balanced by two E. M. Fs.: (1) The E. M. F. expended in overcoming the resistance $R_2$ being equal to $R_2 I_2$. (2) The E. M. F. induced by the secondary rotary field. The angular velocity of this rotary field relative to the armature is $= p_1 - p_2$; therefore

$$E_g = \frac{s_2}{2} (p_1 - p_2) L_2 I_2.$$

If we form a triangle of these three E. M. Fs., and remember that $E_g$ is perpendicular to $R_2 I_2$, and that the angle opposite $E_g = \Phi_2$, and abbreviate by letting

$$r = \sqrt{R_2^2 + \frac{s_2^2}{4} (p_1 - p_2)^2 L_2^2},$$

it follows from the figure that

$$\left.\begin{aligned} \cos \Phi_2 &= \frac{R_2}{r} \\ \sin \Phi_2 &= \frac{s_2 (p_1 - p_2) L_2}{2 r} \\ I_2 &= \frac{m (p_1 - p_2) M I_1}{2 r} \end{aligned}\right\} \quad (71)$$

Putting these values in equation (49), and for the sake of brevity letting

$$N = \frac{m^2}{4} p_1^2 R_2^2 L_1^2 + \frac{s_2^2}{4} (p_1 - p_2)^2 R_1^2 L_2^2 + \frac{m s_2}{2} p_1 (p_1 - p_2)^2 M^2 R_1 R_2 + \frac{m^2 s_2^2}{16} p_1^2 (p_1 - p_2)^2 (M^2 - L_1 L_2)^2, \quad (72)$$

then

$$I_1^2 = \frac{E_1^2 r^2}{N}. \quad (73)$$

The torque is equal to the work done on the armature divided by the difference between the angular velocities $p_1$ and $p_2$.

$$D = \frac{s_2}{2} \frac{R_2 I_2^2}{(p_1 - p_2)} = \frac{m^2 s_2}{8} \frac{(p_1 - p_2) M^2 I_1^2 R_2}{r^2} \quad (74)$$

* For last section of this article see The Electrical World of Feb. 10.

or

$$D = \frac{m^2 s_2 (p_1 - p_2) M^2 E_1^2 R_2}{8 N}. \qquad (75)$$

Substituting the value of $N$, gives

$$D = \frac{m}{2} \frac{b^2 (p_1 - p_2) E_1^2 R_2}{p_1^2 R_2^2 \frac{L_1 m}{L_2 s_2} + (p_1 - p_2)^2 R_1^2 \frac{L_2 s_2}{L_1 m} + 2 b^2 p_1 (p_1 - p_2) R_1 R_2 + \frac{m s_2}{4} b^2 L_1 L_2 p_1^2 (p_1 - p_2)^2 (1 - b^2)^2}. \qquad (76)$$

When $p_2 = 0$, this equation agrees with equation (51).

If we put the leakage $= 0$, or $b = 1$, and divide numerator and denominator by $(p_1 - p_2) R_2$, the denominator will have the following value:

$$\frac{p_1^2}{p_1 - p_2} R_2 \frac{L_1 m}{L_2 s_2} + (p_1 - p_2) \frac{R_1^2}{R_2} \frac{L_2 s_2}{L_1 m} + 2 p_1 R_1.$$

This expression becomes a minimum, or the torque a

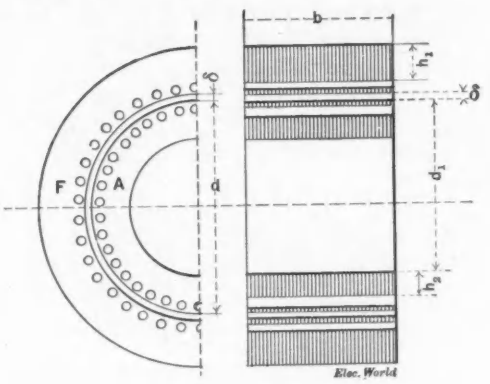



FIG. 16.

maximum, for a certain ratio of $L_1 : L_2$, or for a transforming ratio

$$\frac{s_1}{z} = \sqrt{\frac{p_1 - p_2}{p_1} \frac{s_2}{m} \frac{R_1}{R_2}}. \qquad (77)$$

The E. M. F. induced in the secondary winding is

$$E_2 = (p_1 - p_2) M I_1 \frac{m}{2}. \qquad (80)$$

This value substituted in equation (74) gives, when $K$ represents half the number of poles,

$$D = \frac{s_2}{2} \frac{K E_2^2 R_2}{(p_1 - p_2) [R_2^2 + \frac{s_2^2}{4} (p_1 - p_2)^2 L_2^2]}. \qquad (81)$$

The term $\frac{s_2^2}{4} (p_1 - p_2)^2 L_2^2$ can be neglected in practical cases, as the self-induction $L_2$ of the armature, and the slip, $p_1 - p_2$, are small. Representing the mean secondary E. M. F., $E_2 : \sqrt{2}$, by $\overline{E_2}$, we have

$$D = \frac{K s_2 \overline{E_2}^2}{(p_1 - p_2) R_2}. \qquad (82)$$

The *output of the motor* in watts, which we represent by $W$, is

$$W = \frac{p_2}{K} D,$$

or

$$W = \frac{s_2 \overline{E_2}^2}{R_2} \frac{p_2}{p_1 - p_2}. \qquad (83)$$

Letting $v$ represent the slip, so that, for instance, for two per cent. slip $v = 0.02$, we shall have

$$p_2 = p_1 (1 - v), \qquad (84)$$

and

$$W = \frac{s_2 \overline{E_2}^2}{R_2} \left(\frac{1}{v} - 1\right). \qquad (85)$$

The secondary E. M. F., $E_2$, can be easily found from the dimensions and winding of the motor when the primary E. M. F. is given.

In Fig. 16 $F$ represents the iron core of the field and $A$ that of the armature.

Furthermore, let

$\overline{E_1}$ $(= E_1 : \sqrt{2})$ be the mean primary E. M. F. per phase.

$B$, the intensity of the rotary field per square centimetre in the air space $\delta$ (Fig. 16).

$b$, the width in centimetres of the iron of the inductor and the field.

$d$, the diameter in centimetres of the inductor.

$n_2$, the number of revolutions per minute of the motor.

$K$, the number of pairs of poles.

$N_1$, the number of wires per phase on the inner circumference of the field.

$N_2$, the number of wires per phase on the circumference of the inductor.

For ring winding,

$$N_1 = s_1; \; N_2 = s.$$

For drum winding,

$$N_1 = 2 s_1; \; N_2 = 2 s.$$

The circumferential velocity of the rotary field per second is

$$\frac{p_1 d}{2} = \frac{\pi n_1 d}{K}.$$

Then

$$B = \frac{b_1 K \overline{E_1} 10^8}{2.22 n_1 d b N_1}, \qquad (85)$$

and

$$\overline{E_2} = b_2 \frac{2.22 n_1 d}{10^8 K} b B N_2 v; \qquad (86)$$

or

$$\overline{E_2} = b_1 b_2 \frac{N_2}{N_1} \overline{E_1} v. \qquad (87)$$

(To be continued.)

## Flying Machines.

Although electric power was thought to be of advantage in solving the problem of flying machines, yet it seems that the apparatus of Mr. Lilienthal, of which some interesting instantaneous photographs are reproduced in "Cosmos," Feb. 4, enables a man to fly without the use of any power but that of the wind. He has successfully flown down from the top of a hill and has during his flight even risen higher than the starting point, using the wind for power. From his description, it looks as if the coming sport for young men will soon be the use of such machines, quite a little dexterity being required to keep up the proper balance. They consist simply of a pair of large fixed wings and a large tail, there being apparently no power used but that of the wind and the balancing of the body. His experiments seem to disprove some of the theories formerly held. Some time ago we reported that an electrically driven trolley balloon is to be used to convey visitors to and from the coming Antwerp exhibition.

## Very Long Distance Telephony

In a somewhat speculative conclusion of a recent paper, Mr. Preece mentioned the effects of an aurora on telephone circuits and stated that it was not a wild dream to say that we may hear on this earth a thunderstorm in the sun.

## Gas vs. Steam Engines.

The reports of the installations in Germany show that the number of private installations driven by steam engines were reduced by more than 50 per cent. during one year, while those run by gas engines increased at about the same rate, and there are now more than twice as many of the latter as there are of the former.

# THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

NOTE.—*Owing to the crowded condition of this department the following changes will be made, the object being to enable more space and attention to be given to abstracts of articles and papers of a more important nature. Almost every issue of each of the foreign journals contains descriptions and data, often with illustrations and tables, of local central stations and isolated plants; unless they appear to be of special interest they will not be noticed hereafter. References to descriptions of steam and gas engines, boilers, fuels, etc., and all other subjects not belonging under the heading of electricity and magnetism, will in general be omitted. The Swiss monthly "Journal Telegraphique" (in the French language) contains probably the best telegraph and telephone statistics of the world, and as this Journal is doubtless accessible to those specially interested in this subject, references to such statistics and descriptions in that Journal will hereafter be omitted. Serials in the nature of a treatise on a subject will be noticed only once; this will apply also to papers which are continued in several issues and which are merely referred to in these columns as distinguished from being abstracted. When the same paper or article is reprinted or abstracted in several journals, only the first appearance will be noticed, except if the original is in a foreign language and the reprint is an English translation, in which case the references to the translation will also be given, as usual. Very good abstracts, generally longer than can be given here, are published in the monthly journal of the Institution of Electrical Engineers (London), and in the Proceedings of the Institution of Civil Engineers (London), which abstracts will be noticed only in case the original article has not been mentioned in these columns.—C. H.*

## ELECTRO-PHYSICS.

*High Frequency.*—In referring to a recent article by Lieut. Patten for obtaining high frequencies by means of generators, the Lond. "Elec. Rev.," March 9, states editorially that if an electromagnetic frequency equal to that of the vibrations of light could be set up by a generator the waves would then be light waves, but that at frequencies considerably less than these all conductors of electricity become perfectly opaque and electricity at such frequencies could not pass through copper wire; although such frequencies could probably be obtained, the currents could not be distributed by any known means; it is therefore concluded that in such a system the high frequency must be produced at the point where the light is required, and it is therefore not a generator which is wanted, but a converter of frequencies; it should be remembered that electromagnetic waves of any frequency can pass freely over space or through insulators.

*Propagation of Electricity in Conductors.*—"La Lum. Elec.," March 3, publishes at some length a mathematical article by Mr. Blondin.

*Parallelogram of Forces.*—The "Elek. Anz.," March 4, contains another article by Mr. Schwartze, in which he attempts to prove that the usual conception of the parallelogram of forces is entirely wrong.

*Transformation of Electric Currents.*—Prof. Thomson's recent lecture is abstracted and criticised in "Ind. and Iron," March 9, where some interesting analogies are illustrated by simple diagrams.

## MAGNETISM.

*Density and Magnetomotive Force.*—Under this heading the "Elek. Zeit.," March 1, abstracts briefly the article on page 146 in The Electrical World, Feb. 3; the editor believes to have found an error and claims that the formula for the magnetomotive force is wrong, as the value should have been multiplied by the length of the coil, from which corrected formula he deduces the dimensions of the quantities, showing that the dimensions of the magnetomotive force are the same as those of the electric current. (The author of the original article discussed the formulas as they are often given, and they are doubtless correct; the editor's mistake lies in deducing dimensions of a quantity from a formula which does not contain all the quantities found in its dimensions, owing to the fact that they are equal to unity; the original formula for the magnetomotive force, for instance, is for that which is generated in one centimetre of length, which factor, length, therefore, does not appear in the formula, although it belongs in the expression of the dimensions. That the author did not commit an error is shown in the original article, in which he also introduces the factor length, in his proof. It might be said, without committing any error, that magnetizing force is magnetomotive force per unit of length, in which case there is no ambiguity between the two formulas, provided the proper distinction is made between the total number of ampere turns and the number per unit of length.)

*Earth's Magnetism.*—In the "Elek. Echo," Feb. 17, Mr. Kutschera endeavors to explain the earth's magnetism by assuming currents in the earth's crust running from east to west; he gives a chart showing the calculated and observed directions along an earth's meridian; he assumes that these earth currents are generated as they would be in a dynamo, assuming the sun to be the source of the field magnetism; the results are somewhat elaborately worked out.

## UNITS, MEASUREMENTS AND INSTRUMENTS.

*Electro-Dynamometers Used as Wattmeters.*—"L'Elec.," March 3, contains the conclusion of Mr. Meylan's article, the first part of which was abstracted in the Digest March 10. He discusses the errors due to the self-induction of the fine wire coil; the results only of his deductions can be given here. In such a wattmeter it is the impedance and not the ohmic resistance on which the shunt current depends; he gives the usual formula for the impedance, in which the quantity representing the self-induction is constant only for torsion wattmeters (that is, those in which the two coils are always at right angles); in those in which there is a deflection, the self-induction varies with the position of the coil. If the shunt must be negligible compared with the resistance; he deduces current is to represent the voltage, the reactance ($2\pi I \div T$) a formula, giving the value of the coefficient of self-induction, which must not be exceeded in order that the error in the measurement does not exceed a given amount; for instance, for 300 ohms resistance, a frequency of 125 and an error of 1-2 per cent., the coefficient of self-induction, as found from his formula, will be 0.383 henry; there are no great difficulties in making an apparatus to satisfy these conditions for 100 volts, but below 50 volts it is difficult and even impossible. He then discusses the case where the apparatus consuming the energy produces a difference in phase; in this case if there is absolutely no reactance, the shunt current will have the same phase as the voltage, and the mechanical couple will then be proportional to the true watts; he discusses the case in which the shunt coil produces a lag and shows that when there is no lag in the external circuit the wattmeter measurements are too small, as in a voltmeter; if the lag in

the external circuit is positive and less than half that in the coil, the error is negative, if they are equal it is zero, and if the former is greater it is positive; no matter how small the lag in the shunt coil, therefore, the error may become very great if the lag in the external circuit is very great; a given apparatus can therefore be used only between certain limits, for the calculation of which he gives the formula; he shows that in certain cases, as, for instance, with condensers, choking coils, etc., such a wattmeter cannot be used; with his formula the limits of any wattmeter can be determined; he reduces this formula to the form of curves which facilitate its application; in conclusion he states that good wattmeters may be made of electro-dynamometers for measurements in which the voltage lags behind the current, when this lag is not too great, but that under these conditions the apparatus must be constructed strictly to meet the requirements.

*Photometers.*—An Institution paper read some time ago by Messrs. Barr and Phillips is reprinted in the Lond. "Elec.," March 9. A number of papers are discussed, and it is shown that the eye is the only suitable method of measurement. A diagram is given for selenium grids showing the inconstancy of their resistance ratio, which falls very appreciably and in an erratic manner, in the course of a number of weeks after they are prepared. A number of substances are mentioned by which light may be measured by its actinic effect, among which are the formation of hydrochloric acid by the action of light on a mixture of its constituents, a method by which curves have been plotted which are used in photography; the most promising effect, they claim, is the mechanical expansion of chlorine gas upon exposure to light, an effect which is entirely independent of heating, and the gas recovers its volume upon darkening; this they think is the only known direct mechanical effect of light. In discussing photometers they give a diagram of the percentage errors of the most generally used photometers, from a large number of experiments made under the direction of Prof. Ayrton; the small star spot screen is shown to be the most efficient of all, the percentage error being about 0.35, while for a large grease spot the error is nearly 1 per cent.; the star screen is made by cutting a star out of the centre of two sheets of stiff white paper and pasting the papers from which they are cut together, with a semi-translucent paper between them. In conclusion, they suggest two principles for photometers; in one a cylinder is filled with carbon monoxide and chlorine, which upon exposure to white light is changed into carbonyl chloride, during which process the volume is reduced to one-half; a manometer gives a magnified indication of the pressure, the heat effects being compensated. In the second method two selenium screens are used, the object being to eliminate any variations of the selenium; they are arranged in differential circuit with a differential galvanometer, both being exposed to the standard in succession, the deflections being made equal by adjustable resistances; when both are exposed to the same light there will be no deflection; two lights may then be compared by moving one or the other until no deflection is obtained, a galvanometer deflection indicating simply a difference between the two illuminations; this requires that the grids remain constant only for a moment at a time. In an editorial attention is called to the recent researches of Abney and Festing, showing that when two surfaces are illuminated to an equal brightness with red and green light respectively, and if the light is then diminished in the same ratio, the two surfaces no longer have the same brightness as judged by the eye.

*Photometry of Projectors.*—"L'Ind. Elec.," Feb. 25, contains an article giving in detail the principal parts of a recent paper by Mr. Fery, abstracted in the Digest Jan. 20; in it he shows that for a perfect projector the illumination remains constant up to a certain distance, after which the law of the inverse squares applies; a diagram of the intensities at different distances is given (it resembles roughly a steam engine indicator diagram for a cut-off at one-third stroke); a table is given of the calculated and observed results, showing an approximate agreement (although the error in some cases is over 50 per cent. of the observed value); simple formulas and an example are given, no account being taken of reflection and absorption; it concludes that the figures given regarding the Chicago searchlight are not wrong; it is believed that all confusion could have been avoided if strictly scientific language had been used. In "La Lum. Elec.," Feb. 24, Mr. Fery replies to a recent article by Mr. Guilbert, abstracted in the Digest Feb. 24, correcting some statements made therein; he states that the cross-section of the beam passes through a minimum, the illumination at that point passing through a maximum; this maximum point is at about 100 times the true focal distance from the apparatus.

*Locating Faults in Street Mains.*—In the Lond. "Elec.," March 9, Mr. Collis illustrates and describes a simple method in which a bare wire is laid in the street above the faulty main, insulated from the earth and connected at the ends to the faulty section; a current is passed through the main, and therefore a shunt current will pass through this wire; by grounding one end of a galvanometer and moving the other end over this wire, the fault will lie below the point at which a balance is obtained; the arrangement is an ingenious adaptation of the Wheatstone bridge principle, no calculations being required.

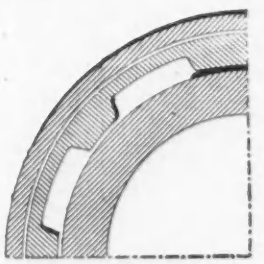
*Liquid Rheostat.*—"La Lum. Elec.," March 3, describes and illustrates the Hirschmann rheostat, consisting of a liquid in a rubber tube, which may be compressed more or less by means of a screw.

*Humphrey & Green's Meter.*—"La Lum. Elec.," March 3, publishes a well illustrated description; a movable and a fixed piece of iron in a series coil measure the currents, which are registered periodically by another solenoid operated by clockwork.

*Theory of Units.*—The paper mentioned in the Digest, March 17, is reprinted in "La Lum. Elec.," March 3.

### DYNAMOS AND MOTORS.

*A New Alternator.*—An alternator of novel construction made by a Swiss firm is illustrated in the Lond. "Elec.," March 9. The field, which is stationary, is made of a cast steel ring, having a U-shaped cross-section containing a single coil; between the two annular poles revolves a cast steel ring (apparently not laminated), having a number of projections, which nearly fill the space between the polar surfaces, as shown in the adjoining figure; the armature coils are fixed on the stationary part, there being twice as many as there are projections; the only movable parts are the shaft



A NEW ALTERNATOR.

and the cast steel notched ring; a very high peripheral speed is obtained and the mechanical strains on the coils are obviated; it is said to suppress completely all magnetic leakage and that the excitation requires about one-sixth of the energy that other alternators do; a 275-kilowatt alternator absorbs but three-tenths of 1 per cent. and the variation between no load and full load is less than 20 per cent.; the in-

ternal resistance is very low, owing to the high magnetic densities used, the armature self-induction is weak and the machines are very easily worked in parallel.

*Alternators in Parallel.*—In a correspondence to the Lond. "Elec. Eng.," March 9, Mr. Metzger discusses the practicability as distinguished from the possibility of running alternators in parallel; he finds that the system of having many circuits any of which can be switched on to any machine is much more reliable than coupling alternators in parallel; he believes that the engineers in charge of stations in which alternators can only be run in parallel would prefer either of the other systems; such engineers do not design their own stations and the designers do not have the responsibility of a heavy winter's run.

*Starting Shunt Motors.*—Mr. Baumgardt in the "Elek. Zeit.," March 1, refers to a previous article abstracted in the Digest Jan. 6, in which he stated that in order to make the starting resistance as small and cheap as possible, the starting current should be taken as large and as constant as possible; he states that if the starting current is approximately constant, a shunt motor will start with a nearly constant acceleration; he discusses at some length all the factors involved in the starting of a motor and in conclusion gives a calculated curve for the relation between the starting time and the accelerated speed.

*Theory of Non-Synchronous Motors.*—A serial of a mathematical nature by Mr. Arnold is being continued in the numbers of the "Zeit. fuer Elek."; it appears to contain somewhat more than his recent article in The Electrical World on the same subject.

*Electric Motors in Factories.*—The Lond. "Elec. Rev.," March 9, describes the installation of motors at the Henley telegraph works, giving a full-page illustration of the switchboard and its connections, the illustration being given also in the Lond. "Elec. Eng."

*Application of Motors.*—In Mr. Richard's well-illustrated serial in "La Lum. Elec.," March 3, are given descriptions of traveling cranes, elevators, fans and other devices.

*Patin & Levavasseur Dynamo.*—An illustrated translation of the description of this machine, mentioned in the Digest March 17, is given in the Lond. "Elec. Eng.," March 9.

### ARC AND INCANDESCENT LIGHTS.

*Illumination.*—Dr. Cohn's article, mentioned in the Digest last week, is abstracted more fully in "La Lum. Elec.," March 3; besides what was given in the former abstract, the following may be of interest: The Hrabowski reflector is described for an overhead arc lamp; it resembles an inverted dishpan with a slightly concave bottom; the upper part is a simple diffuser painted white, while the sides, which are slightly convex inward, are made of wire, coated with a white substance; a small concave opal glass shade is placed below the lamp and a glass ring with a prismatic cross-section is placed around the lamp just below the level of the arc; a sectional diagram, which is not very clear, is given; the disposition of the parts is such that 39 per cent. of the light is reflected directly from the upper part, 42 per cent. passes through the glass prism and is refracted and reflected from the white wires, and the 19 per cent. falling on the hemispherical globe below is partially transmitted and partially reflected on to the upper reflector; 10 per cent. is lost in the glass prism. Measurements showed that in a lecture hall 12 gas lamps over the table gave 17 metre candles, 19 incandescent lamps at 50 volts and 25 amperes gave 18 metre candles, from a mean of 20 measurements an arc lamp with this reflector gave 37 metre candles and a simple arc lamp 16 metre candles; directly below a bare arc lamp he found 17 metre candles, while with this reflector it was 42 metre candles. In another measurement he showed that there was practically no loss by using a reflector (which signifies that the gain of the rays usually lost is equal to the loss in the reflection); the reflector costs as much as the arc lamp. A reflector for side arc lamps in the upper corner of a room is also described, and consists of two reflectors with straight sides shaped like the frustum of a cone open at the large end; the large one is placed in back of the lamp and has a diffusing reflector, while the smaller one is placed in front of the lamp and acts both as a partial transmitter and a partial reflector; the former is placed eccentrically with the lamp; one-half of the light is reflected once and the other half is partially transmitted and partially reflected twice; the whole apparatus resembles a large luminous body illuminated nearly equally; at 1.7 metres from the lamp he found 11.6 metre candles, at 4.1 metres he obtained 7.8 metre candles, and at 10 metres 1.3 metre candles.

*An Early Incandescent Lamp.*—The "Zeit. fuer Elek.," March 1, reprints an article by Mr. Jona from the Italian, in which he quotes from a sort of patent granted to Brusotti Ferdinando di Rosasco, dated Nov. 30, 1877; it describes a lamp in which a refractory material is heated to white heat by being in contact with a conductor; he speaks of the conductor having a small cross-section and great length; for the conductors he suggests metals and for the refractory material calcium, magnesium, etc.; he recommends enclosing it in a glass bulb from which the air has been exhausted as much as possible; he recommends running the lamps in parallel; one of his lamps is still preserved by a society in Milan.

*Lamp for Lantern.*—The Borland arc lamp is illustrated in the Lond. "Elec.," March 9; it consists of two inclined carbons at the end of two levers, which are moved by two solenoids at the other ends of the levers; the cost is said to be considerably less than that of the usual limelight.

### ELECTRIC RAILWAYS.

*Heilmann Locomotive.*—"L'Elec.," March 3, gives a diagram of the connection, which, besides what has already been stated in these columns, shows that the exciter current can be passed through the armature of the main generator, making it a motor, in case the steam engine stops at its dead point; there is no resistance between the generator and the motors; it appears that it takes four men to run the locomotive; the steam admission is constant, the variable quantities being governed by the speed of the machine; there is a hand governor. Diagrams are given of the profile and the speeds, which latter are also given in two full-page tables. In the data about the train it is stated that the locomotive is supposed to start and draw on a level 450 tons and over a curve of 125 metres radius; the maximum horse power of the engine is 800; the weight of the locomotive is 113 tons and the weight of the train 70 tons, making the weight of the train two-fifths of the total; at a speed of 45 kilometres per hour, the drawbar pull was 1,980 pounds and the horse power 150.

In an editorial in the Lond. "Elec. Rev.," March 9, the system is again discussed unfavorably; it is claimed that there is absolutely no value in the contention that such a portable engine will prove more economical than an ordinary locomotive, which can be compounded as well as the Heilmann engines; it is claimed that the principal point is whether it can be shown that with an electrical efficiency of 70 per cent. any engine can be designed for a traveling platform which will be as economical in fuel as a locomotive burning about 17 pounds of coal per mile; it is claimed that the steam locomotive is an economical running engine, and it is feared that the present attempt will tend to bring the advocates of electrical traction into contempt.

*Liverpool Railway.*—In the discussion of the two recent papers mentioned in the Digest last week, reprinted in abstract in "Ind. and Iron," March 9, Mr. Greathead called attention to the fact that the weight of the motor was only 20 per cent. of that of the train, while the steam locomotive of the London underground railway was 40 per cent.; the

tractive effort of the latter per ton of train was 71 pounds, as against 120 pounds of the former; the adhesion was 115 pounds of the electric motor, as against 61 pounds of the steam locomotive per ton of train; the pull was 738 pounds at Liverpool, 367 pounds on the City and South London line, and 234 pounds on the underground steam railway per ton of train, all of which are greatly in favor of having motor cars as against motor engines. The Liverpool overhead railway cost about $450,000 per mile (presumably for the road alone).

*Electric Vehicles.*—An illustration of the Clubbe electric omnibuses, mentioned in the Digest last week, is given in "Ind. and Iron," March 9; it shows an ordinary parcel wagon with the batteries on a suspended train below the rear wheel axle and switches near the driver's seat.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

*Parallel Working of Long Lines.*—The Lond. "Elec. Eng.," March 9, reprints in full an Institution paper by Mr. Mordey. The first portion is devoted to a reply to a recent statement by Prof. Forbes in his Niagara Falls paper, regarding the Mordey alternators; this is reprinted in full in another column. Regarding the "hunting" or regular pulsation of the current, he states that while it may have been caused by self-induction, he thinks the cause must be looked for elsewhere, as the effect of self-induction in his experiments would have been inconsiderable; he thinks the true explanation lies in the character of the resistance and in the governors of the engines; the change in the resistance of the filaments of incandescent lamps accounts largely for the pulsation; an indicator diagram supports the view that the governors of the engine must also be considered; such a diagram is given and consists of a very heavy black line for the descending curve, showing that the steam varied widely during the taking of the card. He described some tests made three years ago with a 25-kw. alternator used as a motor, which tests prove his assumptions in his reply to Prof. Forbes to be justified; other tests are described with a 50-kw. alternator as a motor, the object of which was to ascertain the effect of inserting resistance between two alternators, in one of which the motor ran without a load; the results are given in a table showing that as the resistance increased the current became unsteady, but there was no hunting; the results support the explanation as given, showing that a resistance of about thirty times a reasonable working amount had to be inserted before synchronism was interfered with; if the excitation of the motor had been raised above that required for the minimum armature current, it would be found that it would go out of step with a smaller external resistance than before. Other tests are described with a 25-kw. alternator used as a motor, which was loaded with a constant load, resistance being placed in the circuit between the alternators; even with a very large resistance steady running was obtained if there is sufficient difference between the volts of the generator and the motor; when the motor was loaded the steadiness improved with the addition of the line resistance; the idle current was very small; the relative lowering of the E. M. F. of a synchronous motor, he says, is a necessity in order to obtain good results in power transmission for long distances; the excitation of the motor must be lowered in such a case to give the right E. M. F. He describes some tests of two 100-kw. alternators to find whether they could be paralleled with a considerable resistance between them and their load; with a half load, a voltmeter across the load kept perfectly steady; with full load and 8 ohms in the circuit, there was a very noticeable but not violent pulsation in the synchronizing lamp, but at the load the pulsation was very slight; in another test the two machines were run in parallel with a load close to one of them, but separated from the other by 16 ohms, corresponding to a line loss of about 40 per cent.; there was a pulsation, but they showed no inclination to get out of step. In conclusion he gives some interesting analogies of alternators in parallel by comparing them with two steam engines which drive a common shaft by spur gearing, the teeth representing the successive waves of current; after referring to the operation of coupling when in step, he carries the analogy to the synchronizing abilities of various alternators, comparing alternators with unyielding fields to teeth with great stiffness and small armature reaction, while those with yielding fields to teeth of yielding elastic material, such as soft rubber; in conclusion he shows how unnecessary it ought to be to reduce the number of magnetic teeth or periods in order to get satisfactory and smooth driving, either singly or in parallel, saying that it was only in cases where the electrical spur wheels are so designed that the teeth cannot get in that a small number of periods can be of any service. The discussion is given briefly, but was apparently not revised, and will therefore not be abstracted until the revised report is published.

*Fusible Cut-Outs.*—In the first part of an article by Mr. Anney in "L'Ind. Elec.," Feb. 25, on the present conditions of electric wiring of houses, he proposes to criticise the apparatus used, in which he says very little progress has been made (presumably referring to French apparatus). The present section is on fusible cut-outs; after examining a number of the commercial forms, he states that they do not fulfill the requirements; he discusses the effect of the length of the fusible wire on the fusing current, for which he gives some experimental data; no rule seems to have been followed regarding the lengths nor the maximum voltage at the terminals; fuses should be constructed for a different length for each current; he proposes to use one length for 1 to 15 amperes and another for 15 to 30; the lengths of those examined were insufficient even for 100 volts, none of them being able to stand a short circuit without causing a persisting arc, the force of which was sufficient to explode the case; he discusses the effect of the terminal plates, claiming that to fasten the wire under a screw is very bad practice; round wires of more than about 120 mils in diameter should not be used; only bands should be used for high currents; to proportion wires for a constant amperage per square mil is wrong; for bands of a constant thickness, however, it is correct to increase the width in proportion to the current, which he proves by an experimental investigation; it should not be possible to place a large fuse in a holder for a small one; an important improvement is to arrange the fuses so that no metallic tools are required for their insertion; another improvement in three-wire systems is to have an insulating partition to prevent inserting the fuse between the wrong terminals; metallic covers should never be used.

*Balancing a Three-Wire Station with One Machine.*—In the Lond. "Elec. Rev.," March 9, Mr. Gibson replies to the criticism of Mr. Thursfield, which he claims is incorrect, as any current in the balancing wire could easily be dealt with in that battery by moving the discharge switches, only half the balancing current being required to be passed through the cells; the E. M. F., he claims, can be kept exactly equal, or, if necessary, slightly higher on the proper side.

*Automatic Interrupter.*—The Leconte interrupter is illustrated in "La Lum. Elec.," March 3; the contact is made by mercury in a retaining vessel, the bottom of which is held on by springs; a solenoid operated by a battery and a clock opens the bottom at a predetermined time allowing the mercury to run out and open the circuit.

*Policy of Electric Supply Companies.*—An editorial in "Ind. and Iron," March 9, calls attention to the importance of filling out the load diagram, but gives nothing new; it advocates special rates for work of such a nature as to preclude the possibility of any clashing with existing full load periods;

it believes that companies are not devoting as much attention to this as they ought to.

*Train Lighting.*—A translation of the article by Mr. Grawinkel on the lighting of the German postal cars is given in abstract in the Lond. "Elec. Eng.," March 9, with an illustration of the switchboard.

*Rules and Regulations.*—The rules adopted in the city of Rouen are given in "L'Elec.," March 3, and in abstract in the Lond. "Elec. Eng.," March 9.

*Traveling Crane.*—The Lond. "Elec. Eng.," March 9, publishes a working drawing of a 10-cwt. crane constructed in France.

*Electricity on the Stage.*—Lond. "Lightning," March 8, begins an illustrated article by Mr. Niblett on "Electricity in Stageland."

WIRES, WIRING AND CONDUITS.

*Weight of Copper in Lines.*—In the "Elek. Rund.," No. 11, Prof. Krebs discusses mathematically the relation of the weight of copper to the energy transmitted with continuous, and with one, two or three phase alternating currents, on the basis that in all of them there shall be the same amount of heating; the results are not given conveniently for abstracting; comparing one of them with that of Mr. Weaver in his article recently published in these columns, he obtains 5.83 for two-phase currents, for which Mr. Weaver, on the basis of equal losses, obtained 6.

*Ferranti Cables.*—"La Lum. Elec.," March 3, publishes some good illustrations; each wire is contained in a tube of an insulating material made of a longitudinal piece, which is wrapped spirally with another, leaving considerable air space between the wire and the tube, so that the wires may lie loosely therein; these tubes are then bunched together, being compressed into suitable shapes to make a cable of circular cross-section.

TELEGRAPHY, TELEPHONY AND SIGNALS.

*Telegraph Cable in the St. Gothard Tunnel.*—The Lond. "Elec.," Feb. 23, describes the cable and the laying of it, which was added a few months ago to those already in the tunnel; a cross-section of the cable is given; the conditions were unusually severe, the chief among them being the chemical influences, the uncommonly high temperature in the tunnel, and the danger of mechanical injury. The cable was made by Felten & Guilleaume and consists of 7 cables each of 7 strands, taped and tarred and enclosed in a double lead covering, which is again served with insulating material, over which are 25 peculiarly shaped wires, which interlock and form an extremely close and firm sheathing, which, though strong mechanically, is nevertheless flexible; this is covered with asphaltum, the outside diameter being 2 inches; the chief difficulty in the laying was in the making of the joints, owing to the moist state of the atmosphere in the tunnel.

*Multiple Switchboards for Telephony.*—The Lond. "Elec. Eng.," March 9, calls attention to a recently published pamphlet in German by Mr. Sack, the late director of the German telephone service, in which the three systems, Scribner, Kellogg & Mix, and Genest, are compared, the latter being considered the best; the illustrations are said to be sufficiently clear for those who cannot read the German language.

*Duplex Telegraphy.*—An illustrated report of the legal proceedings of Muirhead vs. the Commercial Cable Company is given in the Lond. "Elec.," March 9; also a brief editorial discussion; the report is published in the Lond. "Elec. Rev."

ELECTRO-CHEMISTRY.

*Electrolysis of Alkaline Salts.*—The Lond. "Elec. Rev.," March 9, discusses the electrolysis of the mixed electrolyte, stating that secondary actions of great importance and some quite unexpected ones are often observed in mixtures under various voltages. In a note in the same issue on the electrolysis of alkali salts, it states tnat when secondary reactions take place preventing the continuous accumulation of these products of electrolysis, the E. M. F. required is determined almost solely by these secondary reactions, and if the result of the latter is the same as with alkali salts, the E. M. F. required for decomposition will practically be the same also, which has been shown by recent experiments, which, if confirmed, will obviate the necessity of assuming the primary decomposition of the water.

*Theryc-Oblasser Accumulator.*—The Lond. "Elec. Rev.," March 9, discusses unfavorably the recent favorable report of Dr. Fleming on this battery (see reference in the Digest Feb. 10; a perforated envelope of celluloid encloses the plates); the report is given, in which it is shown that 7.14 and 6.44 ampere hours per pound of plates was obtained when the discharge was 200 and 180 ampere hours respectively. The criticism claims that the tests are too few and too short to allow of any conclusion being drawn, the question of durability being the most important one; that the battery has a greater capacity than others is claimed to be incorrect; it is not believed that this battery is an advance over some existing and well established types; electricians and users have agreed for some time that the best type of battery in existence is based on the Plante process, and that the use of paste, whether compressed or not, must be considered as a retrograde step.

*Rubber.*—According to "La Lum. Elec.," Feb. 24, it has been discovered that cells containing caoutchouc are contained in plants in which it has not before been found; among them are the Wimmeria, Salacia and Plagiopteron; large quantities of rubber trees have also recently been discovered in Madagascar.

*Electricity of the Skin.*—According to the "Elek. Echo," Feb. 24, Prof. Yarchanoff has shown that any irritation of the skin generates quite a perceptible current; the opening and closing of the eyelid also generates a noticeable current.

*Thermo-Hydrometer for Accumulators.*—The Lond. "Elec. Rev.," Feb. 23, mentions an instrument recently brought out by a London firm which consists of a combination of a thermometer with a hydrometer and intended to overcome the objection to the use of the latter alone, as it gives no accurate values of the strengths of solutions unless the temperatures are also determined. It mentions the rules which Mr. Preece has adopted in measuring the cells in his private installation, in which he uses a hydrometer in each cell and states that it is possible and easy to indicate with absolute accuracy to 1 ampere hour (apparently of a 330 ampere hour cell) the quantity of charge which has been taken out of a cell and the quantity which remains in it.

*Electric Galvanizing.*—"Ind. and Iron," March 2, contains a plan and elevation of a plant on the Cowper-Coles system; the diagrams simply show the four tanks with a revolving crane placed in the centre between them. In hot galvanizing the thickness of the zinc can be varied only within very narrow limits, while in the cold process it can be varied from a few grains per square foot to 1 1-2 ounces; another advantage is that the surface is much smoother, rendering iron plates more suitable for the hulls of fast vessels. A table is given for the various deposits, from which it appears that for the extremes of 1-2 ounce and 2 ounces of zinc per square foot, the thickness is 0.861 and 3.444 mils and the time of immersion 5 and 20 minutes respectively.

*Improvements in Leclanche Cells.*—Mr. Wolff in the "Elek. Zeit.," March 1, describes an improved form, in which the carbon electrode is made of a porous carbon cell, in which the inner filling may be replaced; it is much wider at the bottom, making a sort of shelf half-way up, on which is a porcelain ring supporting the zinc, which is made in the form of a cylinder of sheet metal. For the solution he gives

the formula 84 grams salammoniac, 24 grams kitchen salt and 42 grams of a 50 per cent. solution of zinc chloride, the latter being made by dissolving an excess of zinc in hydrochloric acid and diluting the resulting solution until it has a specific gravity of 1.52, representing a 50 per cent. solution; the object of this is to prevent the crystals from adhering to the zinc; the object of the kitchen salt is to prevent creeping salts from forming; in place of the zinc chloride a little hydrochloric acid may be added to the cell when it is first set up.

*Purification of Sewage.*—The tests at Worthing are described in "Ind. and Iron," March 2; the unfavorable report recently published is not confirmed by these experiments, which bear out the favorable view; the apparatus consists of revolving zinc discs as negative electrodes and rods of brass wrapped with platinum gauze as the positive terminals; 300 amperes at 6 volts are used; the circulation continues until there is 0.5 grain of free chlorine per litre; galvanized iron is employed for tanks and pipes, in which a coating soon forms which protects the metal; great uncertainty seems to exist in regard to the cost of connecting the dwelling houses with the supply pipes. According to an abstract in the Lond. "Elec. Eng.," March 2, Mr. Hermite said that the solution could be brought to the houses for 25 cents per head per annum, allowing 9 gallons per head (per day?), sufficing not only for flushing purposes but also for washing floors.

*Galvanoplastic Bath.*—The Thofehrn bath is illustrated in "La Lum. Elec.," March 3; the liquid is kept in circulation by a pump and an elevated tank.

MISCELLANEOUS.

*Electricity in Plants.*—"La Lum. Elec.," March 3, calls attention to the fact that in all fruits an electric current can be noticed between the eye and the stem, also between other parts of plants, and it suggests that besides using the electric light in plant culture it might be possible to decompose the chemical products in the soil by an electric current, thereby producing fruits and flowers of greatly increased size.

*Reproduction of Diamonds.*—In an Academy paper by Mr. Moissan, reprinted in "L'Elec.," March 3, he reports that he obtained better results by utilizing bismuth instead of iron and immersing it in liquid lead, but even then the crystals were very small; some of the diamonds were striated like some natural diamonds.

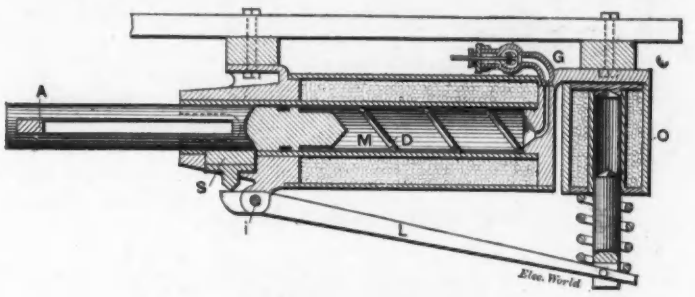
*Lightning.*—In the "Zeit. fuer Elek.," March 1, Mr. Larden describes a peculiar freak of lightning during an ascension of the Matterhorn, a prominent mountain of the Alps.

*Aluminium.*—According to "La Lum. Elec.," March 3, the Neuhausen factory has reduced the price to 5 francs per kilogram (equal to 44 cents per pound), which, it is said, brings the price down to that of an equal volume of the usual metals.

## An Electric Brake.

The electric brake we illustrate, the invention of E. B. Skinner, Ogden, Utah, is intended by its inventor for general railroad and street railway work. Special features claimed for it are that an arrangement is provided whereby the brake shoes are held pressed against the wheels after the brake is set, thereby dispensing with the continuous application of the electric current; for street railway work where the trolley system is used the hand brake can be promptly applied in case the current from the trolley should fail from any cause, both the electric and hand brakes being adapted to operate the same set of shoes.

Referring to the figure, the brake is shown released. To set the brake, a current through the solenoid *O* raises the lever *L*, releasing the pressure of the shoe *S*; a current in the solenoid *M D* then draws in the plunger and brake arm *A*, when the current is discontinued and the brake held by the pressure of the shoe *S* through the lever arm *L* by means of the spring *R*. To release the brake a current is sent through the solenoid *O*, which through the lever *L* releases

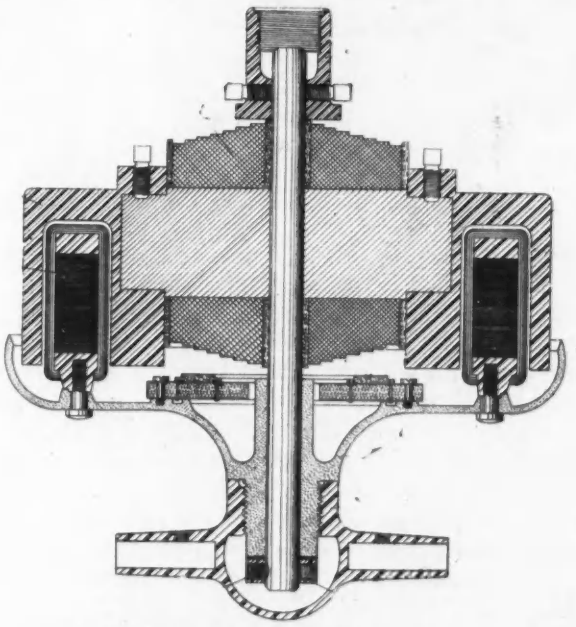



ELECTRIC BRAKE.

the shoe *S*, and the brake plunger is forced out by the spring *D*. *G* is an air valve. A special switch is used to govern these various operations.

## A New Electric Fan.

A new electric fan, manufactured by the Dayton Fan and Motor Company, Dayton, Ohio, has a powerful field, and at the same time is so well proportioned and peculiarly arranged as to be very compact and unobtrusive. The small field coils are made possible by almost completely enclosing



IMPROVED ELECTRIC FAN.

the armature in the pole pieces, thus utilizing every possible square inch of air gap and reducing the magnetic reluctance to a very small amount. The pole pieces which thus enclose the armature serve another important purpose in forming a shell which completely covers the motor and which—finished in black enamel or cream and gold line—makes the motor of highly artistic and ornamental appearance. The stationary shaft is kept bathed in oil from the chamber, as shown in the cut. The results of this excellent designing will be shown in the following figures:

| Voltage. | Speed. | Sweep of blade. | Width of blade. | Angle of blade. | Current. |
|---|---|---|---|---|---|
| 110 | 140 | 60 inches | 8 inches | 30 degrees | .9 |
| 220 | 148 | 60 " | 8 " | 30 " | .5 |
| 250 | 148 | 60 " | 8 " | 30 " | .45 |
| 500 | 172 | 60 " | 8 " | 25 " | .3 |

**These fans are built regularly in windings to suit 110 or**

220 volts direct, or 6 1-2—9 1-2 amperes arc, and of 250 volts, two to be used in series on a 500-volt circuit. A 500-volt fan which has been running in a street railway 500-volt power house for six months, only stopping when the plant was shut down, and in which the pressure varied from 450 to 650 volts, showed no traces of wear except for 1-4-inch of carbon dust and soot, and was as good as when started. The manufacturers state that they will not put their 500-volt fan regularly on the market until after a season's experience with lightning storms in various parts of the country to demonstrate the capacity of its necessarily delicate wires, should the lines be struck.

### New Quick Break Switches.

We illustrate several forms of the Gibbs switch, manufactured by the Perkins Electric and Manufacturing Company, Hartford, Conn., which is based upon an interesting principle. Referring to Fig. 1 the stem of the handle has a screw thread and is connected by a spiral spring to the insulating block, in the centre of which a nut fits loosely. When the handle is turned the spring is put in tension and at the same time the nut is raised until it clears its lock in the base, when the insulating block revolves with great rapidity for a quarter turn; the nut then drops in its seat, where it is firmly held until the switch is again operated. The parts revolve in one direction only. The insulating block is fitted with two compact pins, passing entirely through the insulation and these are fitted loosely in their positions, so as to allow of automatic adjustment between the upper and lower spring copper brushes. When in contact the insulating block is free to move slightly in any direction, and cannot possibly bind the contact pins. All the parts are strong and not liable to give out, but to protect against any trouble, they are made absolutely interchangeable, and can be replaced in a moment should any breakage occur.

Fig. 2 represents the Gibbs flush switch for residence and office installations, which can be made to be operated only by keys, so that no one except duly authorized persons can have access to them. These latter are fitted with a spring lock, which fastens the flush plate to the cast iron box so that no one unprovided with a specially designed key can remove the plate to operate the switch, a provision peculiarly acceptable in insane asylums and other institutions. Another form of the Gibbs switch, the outside of which is made entirely of porcelain, is designed for specially fine or ornamental work, and in which the cover screws to the base. The working parts are the same as in the other types of Gibbs switches, and plain white porcelain is usually furnished except when otherwise requested, when any desired decoration can be procured. Fig. 3 represents a switch, which has been specially designed for breaking 500-volt currents, and is therefore peculiarly adapted for railway and power circuits. It is extremely small, being only 2 1-4 inches in diameter, and the same mechanism is used as in the double pole switch, but by a different arrangement of the screw working device, a break of 1 1-4 inches is obtained, or more than one-third on each side, a result which has not previously been attained. This is a particularly desirable switch for railway work, being neat, and suitable for car work.

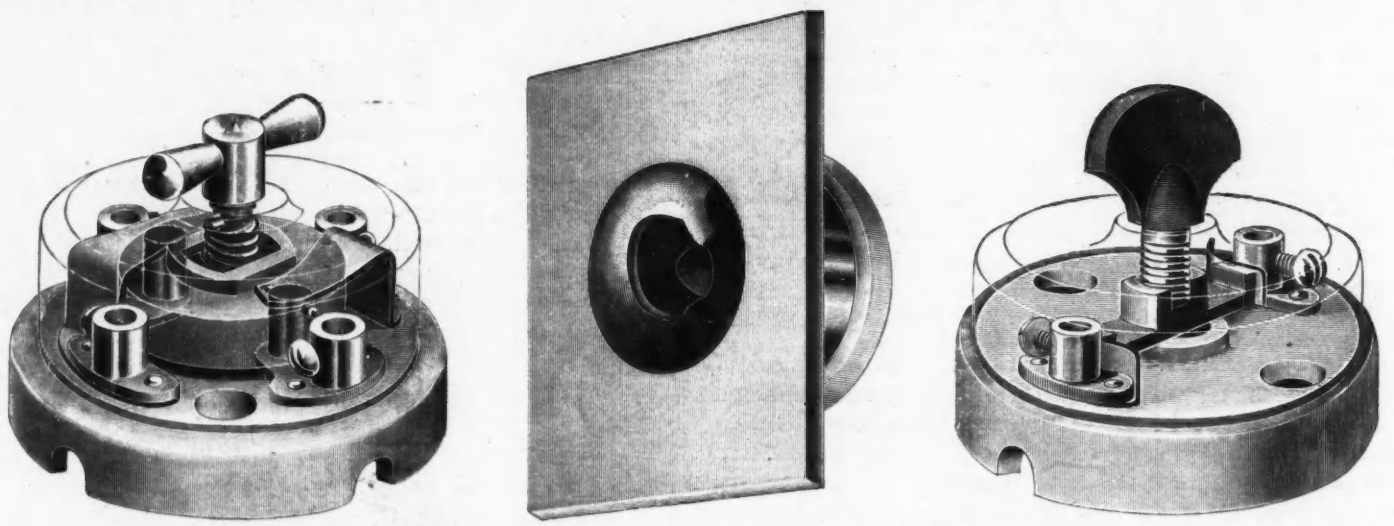
### The Burnley Cartridge Battery.

The battery we illustrate, manufactured by the Miamisburg Electric Company, Miamisburg, Ohio, is a modified form of Leclanche cell, having the containing jar and zinc rod, with a special form of porous cup. The porous cup or cartridge is made of specially prepared paperboard, with sufficient rigidity to withstand the necessary compression. The top of the cartridge is specially paraffined to resist the action of creeping salts. By this construction choking by the deposition of reduced salts within the pores of the cartridge, as is often the case with earthen cups, is avoided. The reduced salts as formed adhere to the extremely fine shreds always present on paper, and having a flimsy support soon drop by their increased weight to the bottom of the jar. Extended practical experience has proved that the paper composing the cartridge will not slough off, but remains as firm in texture after two years' use as it was after the first two hours.

CARTRIDGE BATTERY.

The internal arrangement of the depolarizing compound of carbon and manganese surrounding the negative electrode is such as to utilize all the oxygen present in the manganese, and thus a smaller bulk of this material can be used, thereby reducing the size of the cell, while maintaining its efficiency as compared with other forms of cells. It is claimed that by this arrangement of the depolarizing material the cell is enabled to keep up a more constant E. M. F. than with other forms of Leclanche cells, while its life is equal to the best of the latter.

The novel construction of the cartridges is such that they are only one-half the size of the ordinary porous cup, being 5 3-8 inches high and only 2 inches in diameter, permitting



FIGS. 1, 2 AND 3.—QUICK BREAK SWITCHES.

the use of a small containing jar. The weight of the cartridge, filled and ready for use, is between 14 and 15 ounces, which is only one-third the weight of other porous cups. Being composed of a tough and fibrous paper, they cannot be accidentally broken, an important consideration and much in their favor, which, also, in connection with their small size and light weight, reduces transportation charges.

## A New Telephone.

The telephone which was recently placed upon the market by the Western Telephone Construction Company, of Chicago, and which was illustrated in The Electrical World of March 10, is here shown more in detail. Reference to the accompanying illustrations will give an adequate idea of its construction and operation. The magneto generator is of

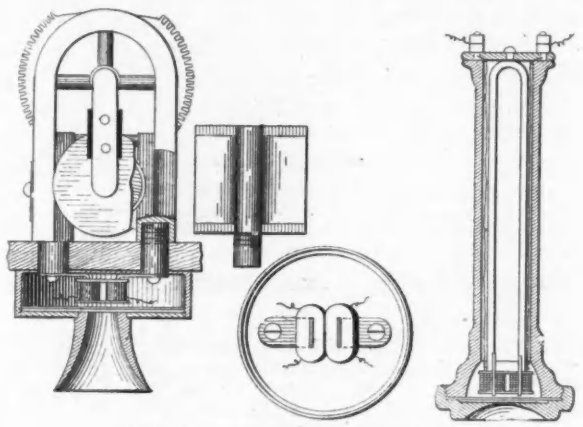


FIG. 1.—A NEW TELEPHONE.

the well-known type ordinarily used for signalling bells and telephone lines. The permanent magnets of the magneto generator are placed with the poles against the door or front of the enclosing case. The armature of the generator is surrounded, as is usual, with soft iron pole pieces which form the cylinder in which the armatures rotate. The disc, preferably of non-magnetic material, is adapted to cover the armature and support the axis upon which the armature rotates. Connected with the soft iron pole pieces are soft iron extensions projecting through the cover of the case and to

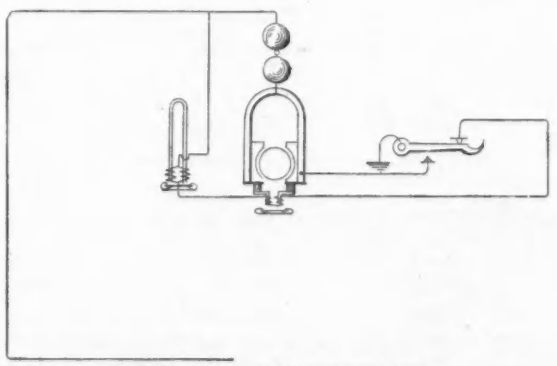


FIG. 2.—A NEW TELEPHONE.

these extensions are attached the angular soft iron pieces, upon the ends of which are wound the coils. The angular pieces are thus in magnetic connection with the permanent magnets of the magneto ringer. The ends of the angular pieces project through the coils and in close proximity with the diaphragm, which is rigidly supported at its periphery in the case, which is provided with a mouthpiece. The diaphragm is of the usual construction of soft iron.

The receiver is of ordinary construction, but instead of using a straight bar magnet, one of horseshoe form is employed. To the ends of this horseshoe magnet are secured and riveted soft iron extensions, around which are wound coils of fine wire. The ends of these soft iron pieces are brought into close proximity with the diaphragm.

As will be seen from the diagram, Fig. 2, the line from the subscriber's outfit, or from one station of a private line, starting from the ground, passes through the contact point when the switch is down, thence through the ringer and out to the line to ground at the exchange or the other station, or back again to the starting point, in case of a metallic circuit. When the telephone is taken off the hook contact is made with the point, as shown, when the circuit is through the two coils of the transmitter, thence through the coils of the receiver, thence by line to the exchange or through station and back again, as before.

It has been found that the connection of the two coils of the receiver in multiple arc produces the best results and the construction of the telephone is such that it not only utilizes the permanent magnets of the ringer, which are usually powerful, but accomplishes the same results as an ordinary battery transmitter in a much more compact and convenient form.

The coils of the transmitter are connected in circuit in series so that double the voltage is secured that would be obtained were but a single coil used, or were the coils connected in multiple.

Many advantages are claimed for this form of construction, and the tests over both long and short distance lines have proved most satisfactory.

## New Books.

DIE ELEKTRICITAETSWERKE, ZU KOELN UND AMSTERDAM. (Central Stations of Cologne and Amsterdam.) By Carl Coerper. Price, $25.

This volume is by far the largest and most elaborately prepared work of the kind which has ever come to our notice. Its size is 15 by 22 inches, and the greater part of it consists of well executed, double-page plates on cardboard. As the title indicates, the volume describes the alternating current stations in the cities of Cologne and Amsterdam and the apparatus of the Helios Company, of Cologne, which erected these stations; this company represents in Germany the well known Austrian firm of Ganz & Co., whose apparatus is that devised by their engineers, Zipernowsky, Deri and Blathy, who were among the earliest workers in the alternating current field.

A full description of the stations is given in the text, together with a large number of illustrations. Besides the description and data of the stations, including tabulated information, load diagrams, etc., there is a chapter on the details, such as the transformers, meters, lamps, motors, switchboards, etc.; among the double-page plates are colored plans of the cities, showing the distribution; also external and internal photographic views of the stations, colored switchboard diagrams, a large number of views of the engines and direct driven alternators, etc.

A description of the Cologne station was published in our columns some time ago, and a number of these cuts, diagrams and tables were there given, further references having been given in our Digest, but those who are specially interested in central station work will find much new matter to interest them in this volume. These stations doubtless form two of the best of those on the Continent using the alternating current system. We have just been informed by the publishers that the English edition of this work has recently gone to press.

The author of the work, Mr. Carl Coeper, is the director of the Helios Company, who, although representatives of the firm of Ganz & Co., of Budapest, have made many important improvements entitling them to be included among the independent companies.

**ELEMENTARY MANUAL OF MAGNETISM AND ELECTRICITY. Specially Arranged for the Use of First Year Science and Art Department and Other Electrical Students. By Andrew Jamieson, M. I. C. E. Third edition. London: Charles Griffen & Co., Ltd. 1894. 297 pages, profusely illustrated. Price, $1.25.**

This manual, we learn from the preface, has been written expressly for elementary and first year students, and while covering the elementary stage of the Science and Art Department examination, is yet intended to be sufficiently general for students who have not these examinations in view.

It seems to be an unfortunate necessity that compels British writers to conform to a government programme in writing their text books. From an author with the well-known practical accomplishments of Prof. Jamieson, we naturally expect a treatment far removed from the time honored academic methods which do not consider the object of the knowledge taught nor the relative weight of its different parts, and were he free from the handicap referred to, there is every evidence in the present work that we would not be disappointed. To illustrate what disadvantages an author has to labor under, and how students suffer from this system of official requirements for text books, it may be said that even after finishing the study of this book, the student would probably be unable to understand scarcely one of the important commercial applications of electricity. It may be said that such books are intended to merely teach the principles of electrical science and thus prepare the student to understand their applications, but a sufficient reply is that these principles should be taught as far as possible in connection with their practical applications, and not uniformly with reference to laboratory models and apparatus.

The practical bent of Prof. Jamieson is visible in many places, as where he illustrates an Edison-Hopkinson dynamo as an example of a short magnet; in the appendices, where practical directions are given to make numerous experimental apparatus, a compass, a detector galvanometer, an electric bell, shellac varnish, etc.; and in the fine type descriptions of commercial apparatus which he interpolates.

Most of the illustrations seem to be original, and in their suggestiveness are far superior to those usually seen in text books. The text is clear and to the point, and, as far as the limitations of the book seem to permit, makes use of practical illustrations to impress principles.

**THE PRACTICAL ELECTROPLATER. A Comprehensive Treatise on Electroplating, with Notes on Ancient and Modern Gilding and Formulas for New Solutions. 298 pages, illustrated. New York: Emile Brunor. Price, $10.**

The external appearance of this volume is somewhat that of an edition de luxe of a literary work, which impression might be further borne out by the extra quality of paper upon which it is printed, the frontispiece portrait of the author, the tailpieces and wide margins were it not removed when we come to pages of advertising at the end of the volume.

Of the 298 pages of the book, 70 are given to electrotyping and perhaps as much more space to historical, personal and miscellaneous matters. The remainder of the work is devoted to the practical operations of electroplating, gilding, dipping and oxidizing, much more space being given to the latter subjects, however, than to electroplating proper. The directions of the author are explicit, and the information, being the result of long and successful personal experience is necessarily more reliable and practical than that found in most other publications on the subject. A cut of a familiar looking dynamo is given twice in the book over the caption "Brunor's Perfected Dynamo," although the name plate on the machine plainly reads "Crocker & Wheeler." In view of the acknowledgment of the author in the preface to Prof. Crocker and Dr. Wheeler for aid in compiling the book, we are rather surprised at some of the electrical matter, as, for example, the discussion of the electrical word "intensity."

**THE PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. By Francis B. Crocker and Schuyler S. Wheeler, D. Sc. With a Special Chapter by H. A. Foster. Second edition, revised and enlarged. New York: D. Van Nostrand Company. 205 pages, 99 illustrations. Price, $1.**

That the first edition of this very useful little book was exhausted within a year is evidence that its undoubted value has been appreciated, and we predict that its popularity will steadily increase in the future. For those who have to do with the practical operation of dynamos and motors this work has a practical value which few books possess, and there is none other with the same object that approaches it in completeness and reliability, nor in clearness and conciseness of expression.

The second edition is considerably enlarged, many additions having been made to the section on examination and testing. Part IV. has been added, giving special instructions for handling Thomson-Houston, Brush, Fort Wayne, Sperry and Excelsior dynamos on account of the special character of these machines; the section on the Thomson-Houston machine, contributed by Horatio A. Foster, is particularly full, the most minute directions being given for its operation and repair and the remedy of the various troubles to which it is subject.

The mechanical execution of the book is not in keeping with its contents. The cuts are unusually poor, the paper is of inferior quality and the margins are cut down to a minimum.

**ENGINEERING EDUCATION; Being the Proceedings of Section E of the World's Engineering Congress, Held in Chicago, Ill., July 31 to Aug. 5, 1893. Edited by De Volson Wood, Ira O. Baker and J. B. Johnson. Published by the Society for the Promotion of Engineering Education. 342 pages. Price, $2.50.**

We referred at the time of the Congress to the important character of the papers read before section E of the World's Engineering Congress, and of the formation of the Society for the Promotion of Engineering Education as an outcome of the meeting, and a closer examination in this volume of the proceedings of the Congress and of the plans of the new society confirms our opinion of the value of the former and the prospects of good results from the latter. Sixteen papers are printed, whose value and that of the discussions appended become more apparent from the following list of some of the authors and those who took part in the discussions: Profs. Burr, Bull, Johnson, De Volson Wood, Thurston, Jacobus, Spangler, Carpenter, Hele-Shaw, Jamieson, Merriman and Lanza. Some thirty professors of engineering participated in the proceedings, and the live interest shown by all of them augurs well for the future of the society then founded. To those interested in education, whether directly or indirectly, this work will be of more than usual interest.

**PARLIAMENTARY TACTICS AND RULES FOR DEBATE FOR THE USE OF THE PRESIDING OFFICER AND PUBLIC SPEAKERS. Arranged by Harry W. Hoot. New York: The Scientific Publishing Company. 52 pages. Price, 50 cents.**

This little book has been prepared to meet a demand for something that would settle all questions of parliamentary law immediately, without referring to text-books, which in themselves are not only voluminous, but tend to confuse and embarrass. The author has used great care in preserving the substance of each question, yet abbreviating to the greatest possible extent, and whatever may be found in any manual now in use will be found in this in a very few words, yet sufficient to be quickly and thoroughly understood.

The index is found upon the margin, where each question is placed in its relative order. The question having the highest order of precedence is placed at the top, and descending in regular order to those in the next order of precedence, to the lowest. Thus can be seen at a glance, and without turning a page, whether a motion is "in order," and on each page are all the rules concerned.

**INDUCTION COILS AND COIL-MAKING. A Treatise on the Construction and Working of Shock, Medical and Spark Coils. By F. C. Allsop. London: E. & F. N. Spon. 162 pages, 118 illustrations. Price, $1.25.**

The author in his preface states that in compiling this book it has been his aim to produce a practical manual that will prove of service not only to those engaged professionally in the construction and repairing of coils, but also to the medical man and amateur coil makers. Dimensions and full details are given for constructing different kinds of coils, accompanied by practical hints and suggestions as to their working and derangements.

In addition to instructions how to make shock, medical and spark coils, there is a chapter on induction, and others on accessory appliances for, and the application of, medical coils, on experiments with spark coils, batteries for coil working, faults in medical and spark coils, and on figures produced by electric discharges on photographic plates.

The author, in addition to his own contributions, has collected together much information from other sources, and the work can be recommended as probably the best that has yet appeared on the subjects treated.

**ELECTRICITY AND MAGNETISM. An Elementary Course. By C. G. Knott (Edin.), F. R. S. E. Philadelphia: J. B. Lippincott Company. 1894. 239 pages, 175 illustrations. Price, 75 cents.**

This is a work written on typical academic lines and, were it not for one or two of the numerous cuts, would give little evidence that it was not written in 1853 instead of 1893. From the preface we learn that the book is designed primarily to suit the needs of students entering the first stage of the English Science and Art Department, and that the exercises at the end of most of the chapters are in part compiled from the examination papers of the same department. The work is thus written for a special English audience, and the writer is therefore not wholly responsible for the entirely academic character of the book. If used merely as part of a course of mental training, in which the practical bearing of the knowledge taught has no weight whatever, as, for instance, in schools for girls, the book may serve a useful purpose, but otherwise it has little value as a first book in electricity and magnetism in comparison with other text books in which there is a more practical perspective.

## NOTES.

The Smithsonian Report for 1891, which has just been issued, contains a translation by William Hallock from the German of an address delivered before the Royal Bavarian Academy of Sciences by Eugene Lommel on "The Scientific Work of George Simon Ohm." (Washington, D. C.)

"Electricity Up to Date," by John B. Verity, has again appeared in a new edition, the fourth; 15,000 copies have already been sold, which is evidence of a due appreciation of a work by the popular audience for which it has been written. The present edition has been largely rewritten, and a new chapter added on electric heating and cooking. (London: Frederick Warne & Co. Price, 75 cents.)

The National Electric Light Association has issued its report of the sixteenth convention, held at St. Louis, Feb. 28—March 2, 1893, which forms a handsome volume of 430 large octavo pages, and contains a frontispiece photogravure of Mr. James I. Ayer, the president of the St. Louis meeting. The character of papers read gives this volume a permanent value not possessed by some of the other reports of the Association. Nikola Tesla, Prof. Forbes, Dr. Bell, L. B. Stillwell and C. S. Bradley are some of those who read papers of especial value, while most of the other papers and parts of the discussion contain much information of practical importance. (New York.)

We have received from the Oerlikon Company, of Zurich, Switzerland, an interesting set of photographic views of their traveling beam electric cranes, showing a number of details of construction; also of a crane, traveling on a surface track taking its current from the trolley wire; also illustrated price catalogues of cranes and elevators, hanging boring machines and a very useful tool for a workshop in the form of a boring machine carried on a light truck and operating the drill through the medium of a flexible shaft; all of these are driven electrically, and the constructions are characteristic of the good workmanship for which this company is noted.

"Telephone Lines and Their Properties," by Prof. William J. Hopkins, has passed into another edition, which, the title page states, is revised and enlarged. No indication is given as to the extent of the revision or the character of the additions in the preface or elsewhere, though we find that the pages have been increased from 258 to 272. The success of this work, which we predicted in our review, follows not only from its intrinsic value, but also because it is the only work, aside from Preece and Stubbs' treatise (to which it furnishes an admirable complement and extension) that deals with the modern aspects of telephony. (New York: Longmans, Green & Co. Price, $1.50.)

"The Book of the Fair," now being issued in parts of 40 pages ($1.00 each), will, when completed, form a magnificent volume of 1,000 pages, twelve by sixteen inches in size. The paper, typography, engraving and letter press are all in keeping with the high aims of the publishers, which are doubtless to produce a memento of the World's Fair that will be as much superior to publications relating to previous expositions as the Chicago Exposition was superior to all of its predecessors. Part XI., which is devoted mainly to the electrical features of the fair, treats this portion very satisfactorily. The subjects for illustration have been well chosen and the engravings are fine specimens of photographic reproduction, the Franklin statue being particularly well executed in a fine full-page engraving. The list of subjects is necessarily somewhat brief, but the descriptions are technically correct, which is not always the case in works of this character. (The Bancroft Company: Chicago and San Francisco.)

The "Physical Review" for March-April, 1894, contains a frontispiece portrait of Heinrich Hertz and a biographical sketch by Prof. E. L. Nichols. Prof. Carhart gives the result of some experiments as to the effect of the surrounding medium on the electrical conductivity of copper, and concludes, contrary to the opinion of Prof. Sanford, that surrounding medium has no effect. John Daniel continues his paper on "A Study of the Polarization Upon a Thin Metal Partition in a Voltameter," discussing in this section the passage of ions through a gold leaf partition in a voltameter, and the minimum or critical current at which ions are deposited visibly upon the partition for various electrolytes. He finds that in such a voltameter as was used in his experiments, there is no passage of copper ions through a gold leaf partition, and gives tables of the critical current for a number of electrolytes. Knut Angstrom gives a quantitative determination of radiant heat by the method of electrical compensation, Profs. Nichols and Moler describe an apparatus for generating oxygen and hydrogen by electrolysis, and Louis W. Austin has a note on the effect of extreme cold on magnetism. Prof. Macfarlane reviews McAulay's "Utility of Quaternions in Physics," and J. J. Thomson's "Notes on Recent Researches in Electricity and Magnetism" is reviewed by H. B. Loomis. The electrical contributions, as will be seen from the above enumeration, form a goodly proportion of the contents. (Macmillan & Co.)

# Financial Intelligence.

## The Electrical Stock Market.

NEW YORK, March 24, 1894.

GENERAL ELECTRIC STOCK has had its usual ups and downs this week. There is a likelihood, however, of the stock soon being put to higher figures, although the people that bought the stock from 32 upward are taking advantage of every rally around present prices to market some of their paper profits. There isn't much stock of this kind left for sale, however, and a new bull pool, encouraged by the success of the first crowd that is now taking in profits of 10 and 12 points, has been formed to push the price several points still further up. Business with the company has been very good of late. As intimated in these columns last week, the identification of interests in the Cataract Electric Company and the General Electric Company has been of the greatest value to the General Electric Company, as it has just signed contracts with the Cataract company for $100,000 worth of machinery, which will be built at Lynn. This is but the beginning of a source of business that will develop enormous proportions. Then the General Electric Company has just closed an important contract with the Edison Electric Illuminating Company, of Brooklyn, for several large electric dynamos and a considerable quantity of underground apparatus, conduits, etc. The order amounts to over $100,000, and the work is to be done at the Schenectady shops. There are still some bears on the stock, however, in the face of these announcements. They maintain that, while business is evidently increasing, profits are an unknown quantity. It is asserted that new business is being taken at ruinous rates, and earnings, so far as any one is aware of their extent, do not suggest early payment of dividends. The most persistent argument they use relates to the question of cutting down the capital. In this connection a leading director of the General Electric Company is quoted by Dow, Jones & Co. as saying: "The idea of reducing the capital is a suggestion which has originated outside of the company and has not yet been considered inside. It seems to be a popular suggestion, especially at Boston. As to the New York State law in regard to impairment of capital, it applies to payment of dividends only out of profits. When capital is impaired, it is a misdemeanor to pay dividends." The annual meeting of the stockholders is called for April 10 at Schenectady; its outcome and the reading of the annual report are awaited by Wall Street with a deal of interest.

WESTINGHOUSE ELECTRIC matters continue featureless; none the less both preferred and common stocks hold very strong. Some figures just compiled in Boston confirm the statement published in these columns two weeks ago that "the Westinghouse company does 70 per cent. of the entire business handled by it and the General Electric Company, and on a capitalization, par value, of $9,089,640, as compared with the General Electric's capital of $44,708,900." The Boston expert this week figures the capitalization of the Westinghouse company at $9,692,000, and that of the General Electric Company at over $44,000,000, and remarks that the former company, "with one-fifth the capital stock of the latter, is believed to be doing practically the same gross and a relatively better net business." As an indication how the Westinghouse company is pushing matters, it may be noted here that the West End Street Railway of Boston has closed a contract with the Westinghouse company for 150 car equipments, and 50 additional, if needed. This is the first contract ever made with the Westinghouse company, all previous contracts having been made with the General Electric Company.

WESTERN UNION TELEGRAPH stock has been strong all the week, and its course is considered one of the best tests of the solidity of the whole stock market. The stock has been quoted "ex" the regular dividend since Monday and recovered the 1¼ per cent. in the face of the bad showing made by the winter quarter's earnings. A good deal of the rise has been due to covering by shorts, who relied upon the bad March statement to break the price of the stock wide open. In this they were disappointed, as there was no liquidation. Mr. George Gould denies emphatically the revived rumors current that he and other large holders of Western Union have been steadily letting go their lines. He insists that his individual holdings and also the holdings of the Gould estate are larger than even a year ago, due to the declaration of the recent scrip dividend.

EDISON ELECTRIC ILLUMINATING, of New York, stock has been quite strong this week. Bond experts recommend the purchase of the company's 5 per cent. bonds around 104, on the ground that the stock has recently gone up from 90 to par, and these bonds are convertible into common stock at par up to July 21, 1895. Electrical circles find interest in a circular just issued by the company to large users of its lamps, stating that prices are being reduced materially from those recently quoted to patrons who will make contracts to take all the lamps they may require for the next five years from the company. It is supposed that this is due to the coming expiration of the patent, and is regarded as a shrewd move on the part of the company.

AMERICAN BELL TELEPHONE continues the subject of bear attacks. Announcements are made on all sides of forthcoming competition. For instance, it is stated that a syndicate, including Philadelphia traction magnates, Standard Oil interests and Pennsylvania Railroad officials have purchased for $250,000 a French telephone patent known as the Clamond system and that they will operate these telephones to compete with the Bell company. Again it is announced that next week the Bell Telephone Company will be made the defendant at Toledo, Ohio, in a patent suit involving $5,000,000 damages for appropriating, as alleged, a multiplex switchboard invented by M. J. Carney, at one time in the employ of the company. In relation to the report that the Western Union Telegraph Company may enter the telephone field by buying hand telephones and attaching them to its wires upon the expiration, in 1896, of the contract with the American Bell Telephone Company, it is said that the Western Union Company has less than six copper wires between New York and Boston. The Postal Telegraph Company claims 16 copper wires between the two cities and four big iron wires, which they say are as good as copper. The annual meeting of the Bell company's stockholders will be held on the 27th inst., when officers for the ensuing year will be elected, and such other business as comes before the meeting will be transacted.

THE COMMERCIAL CABLE COMPANY has declared a regular quarterly dividend of 1¾ per cent., payable April 2. The stock remains steady around 125.

THE NASSAU ELECTRIC RAILWAY COMPANY is a Brooklyn corporation that intends to build, at an expenditure of over $12,000,000, 100 miles of electric road in Brooklyn and its vicinity. The electrical companies are eagerly competing for the contract, so far unlet, for furnishing electrical equipment. It is likely, however, that the order will be divided among the General Electric, Westinghouse and other companies. Attention is called to this for the reason that it is a well-known fact that all the companies are underbidding each other in the motor field. Thus, the Curtis company, a concern that has just entered the field, recently got the Brooklyn City contract away for 80 motors from both the General Electric and Westinghouse companies, and, it is said, at a price below $1,000 per car equipment. There was a time when $3,600 per car was considered but a fair price. In the same way the Philadelphia Traction Company recently awarded a big contract at less than $1,000 per car equipment.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Philadelphia, has declared its usual quarterly dividend of 2 per cent. and an extra dividend of 1-5 per cent. If this rate of dividend continues for two years the company's security will have the distinction of being a 28 per cent. stock. Considering the hard times this company's earnings for the past three months are remarkable and indicate the value of this illuminating property.

ELECTRICAL STOCKS.

| | Par. | Bid. | Asked. |
|---|---|---|---|
| Brush Ill., New York | 50 | 20 | 35 |
| Detroit Electrical Works | 10 | 2 | 3 |
| Cleveland General Electric Co | — | 85 | 90 |
| East River Electric Light | 100 | — | 65 |
| Electric Con. & Supply Co., pref | 15 | 15 | 16 |
| " " " " com | 15 | 15 | 17½ |
| Edison Electric Ill., New York | 100 | 99 | 100 |
| " " " 1sts | — | 105 | 105¼ |
| Edison Electric Ill., Brooklyn | 100 | 102 | 105 |
| " " " Boston | 100 | 112 | 115 |
| " " " Chicago | 100 | 125 | 130 |
| " " " Philadelphia | 100 | 130 | 132 |
| Edison Electric Light of Europe | — | — | 3 |
| " Bonds | — | 80 | 85 |
| " Ore Milling | — | 10 | 11 |
| Fort Wayne Electric | — | 4½ | 6½ |
| General Electric Company | 100 | 42¼ | 42½ |
| " " " deb. 5's | — | 83½ | 84 |
| Interior Conduit and Ins. Co | 100 | 20 | 30 |
| Mount Morris Electric | — | — | 65 |
| Westinghouse Consolidated | 50 | 32 | 33 |
| " " " pref. | 50 | 49 | 50 |
| Western Union Telegraph | — | 85¼ | 85⅜ |
| American Bell Telephone | — | 182 | 183 |

## New Incorporations.

THE NORTHERN ELECTRIC RAILWAY, Chicago, Ill., capital stock $50,000, has been formed to construct and operate dummy and street railroads, etc. R. McMurdy, F. W. Job and M. S. Gilbert, are the promoters.

THE WYOMING ELECTRIC LIGHT AND POWER COMPANY, Wyoming, Pa., capital stock $5,000, has been formed to furnish light, heat and power. R. T. Pettebone, R. E. Pitchins and J. N. Nuss are the incorporators.

THE BOWER MACHINE COMPANY, Chicago, Ill., capital stock $40,000, has been formed to purchase and sell electrical devices, machines and other apparatus. C. O. Johnson, F. E. Taylor and J. F. Bower are the organizers.

THE CAPITAL CITY LIGHT AND FUEL COMPANY, Tallahassee, Fla., capital stock, $30,000, has been formed to operate gas and electric light works, etc. W. M. McIntosh, W. A. Rawls and Dougald McLachlan are the promoters.

THE CITIZENS' ELECTRIC LIGHT COMPANY, Leadville, Col., capital stock $25,000, has been formed to furnish electric light, etc., to the town of Leadville and vicinity. D. La Salle, R. J. Cary and G. P. Brown are the promoters.

THE COLORADO SPRINGS GAS AND ELECTRIC COMPANY,

Colorado Springs, Col., capital stock $150,000, has been formed to produce electricity and gas. T. H. Edsall, J. A. Hayes and I. Howbert, Colorado Springs, Col., are interested parties.

THE AMERICAN ELECTRIC COMPANY, Toledo, Ohio, capital stock $10,000, has been formed to buy and sell electrical apparatus and patents incident thereto. O. S. Brumback, F. H. Hurd, C. F. Wall, C. A. Thatcher and S. C. Schenck are interested parties.

THE READING AND WOMELSDORF ELECTRIC RAILWAY COMPANY, Reading, Pa., capital stock $30,000, has been formed to construct and operate an electric railway in Berks County, Pa. M. C. Aulenbach, A. B. Hawk and S. E. Rigg are the promoters.

THE BREESE AND MANSFIELD COMPANY, Jersey City, N. J., capital stock $100,000, has been formed to buy and deal in machinery pertaining to electricity, etc. C. P. Breese, New York; E. J. Emerson and F. Mansfield, of Jersey City, N. J., are the promoters.

THE EATON ELECTRIC LIGHT, POWER AND ICE MANUFACTURING COMPANY, Eaton, Ohio, capital stock $50,000, has been formed to produce electricity, ice, etc. The incorporators are H. C. Aydelott, J. S. Banner, D. W. Cooper, W. C. Dove and C. C. Aydelott.

THE LYCOMING IMPROVEMENT COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to build, purchase and sell plants for producing and furnishing light, heat and power. J. R. T. Davis, G. G. Davis, Philadelphia, Pa., and C. N. King, Jersey City, N. J., are the promoters.

THE BLUEFIELD ELECTRIC RAILWAY COMPANY, Bluefield, W. Va., capital stock $20,000, has been formed to construct and operate a railway between Bluefield, W. Va., and Graham, Va. The organizers are J. M. Wiryman, W. H. Triol, J. W. White and F. W. Halsey, Philadelphia, Pa.

THE NORTH BALTIMORE WATER AND ELECTRIC COMPANY, Baltimore, Md., capital stock $80,000, has been formed to operate and maintain a system of waterworks, electric light and power plants, etc. G. E. Downing, L. Wooster, C. W. Jones, A. G. Henry and J. Richank are the promoters.

THE KINSMAN AND FARMDALE RAILWAY COMPANY, Kinsman, Ohio, capital stock $10,000, has been formed to construct and maintain, by electrical or other means, a standard gauge railway. D. M. Yeomans, J. A. Russell, F. W. Forbes, E. R. Brackin and Allen Jones are the promoters.

THE HOUSTON AND SUBURBAN STREET RAILWAY COMPANY, Houston, Tex., capital stock $100,000, has been formed to construct and operate a street railway in Houston to be operated by electrical or other means. A. Christeson, W. A. Wilson, Jr., and E. W. Cove, Houston, are the incorporators.

THE OHIO AND INDIANA PIPE LINE COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to construct and operate electric light plants, etc. E. R. Chapman, S. M. Brice, T. W. Scarborough, New York; S. Shortridge, Brooklyn, N. Y., and A. Williams, Paterson, N. J., are the promoters.

THE EASTERN AUTOMATIC TELEPHONE COMPANY, Jersey City, N. J., capital stock $500,000, has been formed to manufacture and construct, etc., electrical and other apparatus. The promoters are C. H. Scrymser, Brooklyn; C. L. Tappan, Babylon, L. I., N. Y., and C. E. Renshaw, East Orange, N. J.

THE CLARKSBURG TELEPHONE COMPANY, Clarksburg, W. Va., maximum capital stock $1,000,000, has been formed to purchase, manufacture and sell telephone apparatus, and to operate telephone and telegraph lines, etc. The organizers are D. P. Morgan, N. J. Coplin and T. M. Hickman, all of that town.

THE EUREKA LIGHTING COMPANY, San Francisco, Cal., capital stock $250,000, has been formed to manufacture and deal in electricity for all purposes. J. H. Livingston, William Clift, W. D. Clark, Hy. Williams, H. M. A. Miller, San Francisco; O. G. Miller, Oakland, and Joseph Hutchinson, Palo Alto, Cal., are the organizers.

THE COLLEGE HILLS AND PARK LINE, Sherman, Tex., capital stock $100,000, has been formed to maintain a street railway to be operated by electricity or other power in and through that town. J. P. Harrison, W. M. Scott, L. C. Chapman, R. S. Dorchester, D. A. Simmons, H. N. Tuck, J. R. Cole, J. M. Cullers and Geo. F. Henry, all of Sherman, are interested.

# Special Correspondence.

## New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row NEW YORK, March 26 1894.

THE PECKHAM MOTOR TRUCK AND WHEEL COMPANY, 26 Cortlandt street, New York, has opened a Boston office, of which Vice President A. W. Field will have charge.

MR. CHAS. E. CHAPIN, 136 Liberty street, New York, Eastern agent for the sale of the Packard incandescent lamp, reports having recently received several large orders for this well-known lamp.

THE BALL & WOOD COMPANY, Elizabethport, N. J., has sent an invitation to its friends in the vicinity of New York to visit its works on March 31, to inspect a new type of vertical engine of 600 h. p., previous to its shipment to the Chicago Edison Company.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, and Equitable Building, Baltimore, has been appointed by the Buckeye Electric Company, of Cleveland, Ohio, as its sole agents for New York and Baltimore and their vicinities.

THE SWITCHBOARD of the United Electric Light and Power Company's station on West 29th street, and part of the building were destroyed by fire on Monday morning. In pulling the switches when the flames were observed, the engineer, Samuel Hicks, was burned about the face. The fire is reported to have been caused by a short circuit.

MR. THOMAS L. SCOVILL, who during the past seven years has been the New York agent of Holmes, Booth & Haydens, will on April 1 sever his connection with the above-named firm. Mr. Scovill has accepted the presidency of the Mechanical Boiler Cleaner Company (working under the Stewart patent), and will be located at 32 Park place. His company will also deal in brass and insulated wire, together with articles manufactured in brass and aluminium.

BROOKLYN, N. Y.—The Atlantic Avenue Railway Company, owned by the Brooklyn Traction Company, has the following officers: President, Benjamin Norton; secretary-treasurer, W. J. Richardson; auditor, Charles Colne; superintendent, H. R. Newkirk; purchasing agent, W. M. Tobias. There are 44 miles of road, and 440 cars, of which 233 are Westinghouse motor cars. The Brooklyn Traction Company's offices are in the Bartlett Building, Philadelphia. C. F. Stevens is secretary and treasurer.

PRIMARY BATTERY SUIT.—On March 13, Judge Aldrich, of the United States Circuit Court, of the District of Massachusetts, handed down a decision sustaining the patent on the agglomerate cup of the well-known Holtzer cylinder battery, manufactured by the New York Carbon Works, New York City. The Judge decided that the complainant's invention "must be accepted as a valuable improvement upon the means previously employed in this kind of battery," and ordered a decree for an injunction and an accounting.

MR. CYRUS ROBINSON has severed his connection with the General Electric Company and has accepted one as designing engineer with the Jeffrey Manufacturing Company, of Columbus, Ohio. Mr. Robinson has been with the General Electric Company as designing engineer for the power and mining department. The Jeffrey company has been in the mining business for a number of years, and it is its intention to increase its business and commence the building of electrical mining plants, including generators, mining machines, haulage plants, pumping and hoisting apparatus, etc., for coal and ore mines. Mr. Robinson's past experience well fits him for his new position.

## New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., March 24, 1894.

PRESIDENT M. J. FRANCISCO, of the National Electric Light Association, and his son, were in Boston this week.

THE SHAWMUT FUSE WIRE COMPANY, of Boston, has a new manager in Mr. M. Metcalf, a young gentleman of business ability, succeeding Mr. McFerriday, who is absent in Colorado for his health.

THE WESTINGHOUSE ELECTRIC COMPANY has secured its first order from the West End Street Railway Company, of Boston, and it is a pretty good one, as it is for 150 car equipments positively and 50 additional, if needed.

THE PHILLIPS INSULATED WIRE COMPANY, of Pawtucket, R. I., with its new and handsome building, is quite the attraction electrically in that city just at present, and Mr. H. O. Phillips and Secretary Smith are never happier than when expatiating upon their delightful home and surroundings.

THE DWIGHT SLATE MACHINE COMPANY, of Hartford, Conn., a corporation enjoying an excellent reputation as manufacturers and dealers in machinery, tools and supplies, makes a splendid display in its new warerooms at 13 Central Row, opposite the post office. Its popular and capable manager, H. N. Hinckley, complains a little of the dull times, but says he is kept busy.

MR. JOHN M. FOX, electrical engineer and contractor and dealer in electrical supplies, Portland, Me., has removed to larger and more commodious quarters at No. 66 Union street, that city. The change was necessitated by his rapidly increasing business. In addition to a complete and large line of electrical goods, Mr. Fox now carries an excellent supply of gas and electric fixtures, shades, etc.

MR. CHAS. W. HOLTZER, of the Holtzer-Cabot Electric Company, Boston, has obtained a favorable verdict from Judge Aldrich,

of the United States Circuit Court, District of Massachusetts, in his suit against the Consolidated Electric Manufacturing Company for infringement of his patent on the construction of galvanic batteries, under Letters Patent No. 327,878 and known as the "Holtzer Cylinder Battery."

MR. FRANK S. DE RONDE, general sales agent for the Standard Paint Company, of New York, was in Boston this week and favored this office with a call in company with Mr. Chas. B. Price, of Pettingell-Andrews company, its representative in New England. The presentation of Mr. De Ronde's card was accompanied with one of the "P. & B." Perfectos, the choice fragrance of which must still linger in the memory of all who were fortunate enough to get one at the recent Washington convention.

MR. J. F. BUBERT has succeeded to the construction and engineering departments of Claflin & Kimball, formerly general agents of the Mather Electric Company, and has opened an office in Room 71, Hathaway Building, 620 Atlantic avenue, Boston. Mr. Bubert identified himself with the Mather company in 1884, and in 1887 assumed charge of the construction and engineering departments for Claflin & Kimball, general agents. He possesses exceptional ability and valuable experience in these particular branches of electrical work, and will unquestionably meet with the success he justly deserves.

ELECTRICITY AND PROPOSED LEGISLATION thereon have been quite prominent in Boston this week. The daily papers are devoting considerable space, sensationally of course, to the "breezy tilts" between ex-Congressman Geo. Fred Williams and Attorney Hyde, of the West End road, in connection with the aldermanic hearing on the burying of overhead wires. The street railway transfer question has also cut quite a figure in state legislative committee meetings, and the struggle between the electric railways and steam roads has been made decidedly manifest owing to proposed amendments relative to grade crossings.

THE WEST END STREET RAILWAY COMPANY has perfected plans for the extension of the electrical service the coming season, and the following are the districts that are to be thus equipped: All of East Boston, the incompleted portion of Brookline, Mt. Auburn street and Huron avenue in Cambridge, Malden and Medford and minor extensions in Somerville and other suburbs. The electric track welding machine, whose work was seen last season in Cambridge and on Shawmut avenue, has been improved to meet certain deficiencies that were demonstrated by experience, and is expected to be put at work again here soon after April 1.

ALMON & SARGENT, electrical engineers and contractors, is the title of a new firm, with offices just opened in the Hathaway Building, 620 Atlantic avenue, Boston. The members of the firm, however, are not new to the electrical public, both of them having been connected with the construction departments of the Thomson-Houston and General Electric companies, of the former of which Mr. Almon was superintendent for a long time. Their abilities are as well known and recognized as they themselves are. The firm will also act as general agents for the Belknap Motor Company and L. P. & D. Transmitter Company, with offices in Boston and New York. Mr. Almon has for some time been doing some very successful work in New York for these companies.

THE LONG AND BITTER CONTEST, on the one side, at least, between the town of Wakefield, Mass., and the Citizen's Gas and Electric Light Company, is about at an end, as the award of Commissioners E. B. Hale, S. L. Powers and I. T. Drew has been filed in court, and is to the effect that the town must pay $154,600 for the plant. This litigation was one of the first in the interest of municipal lighting and the Citizen's company, through its well and favorably known vice president, H. C. Buck, has from the commencement occupied simply a defensive position. The decision of the commissioners is in accord with the statute compelling a town to take the existing plant if it votes twice to establish a lighting plant. The plant of the Citizen's company is a model one in every respect.

## Canadian Notes.

TORONTO, March 21, 1894.

THE PROPRIETORS of Winona Park have decided to refuse to allow the Hamilton, Grimsby and Beamsville Electric Railway to use the park for excursions, as they desire it for the use of lot owners only.

THE BOARD OF MANAGERS of the Galt and Preston Electric Railway met on Saturday last, and opened tenders received for the construction of the electrical part of the road. The contract was given to Ahearn & Soper, of Ottawa.

THERE IS CONSIDERABLE TALK of again submitting the question of Sunday cars to the vote of the people in Toronto. It has now been twice defeated, but Sunday car advocates are determined to keep at the matter until cars are permitted to run on Sunday.

A BILL HAS BEEN BROUGHT up in the Local House to incorporate the Toronto and Richmond Hill Electric Railway. It is proposed to extend the present line of the Metropolitan Railway right up Yonge street to Richmond Hill, a distance of about 20 miles.

AT A GENERAL MEETING of the shareholders of the Montreal Street Railway, held on the 19th inst., it was resolved in increase the capital stock of the company from $2,000,000 to $4,000,000, and the directors were empowered to issue new bonds to the extent of the increase at such times and in such amounts as they might see fit.

A VERDICT has been given by the Privy Council in the case of the Winnipeg Street Railway versus the new Winnipeg Electric Railway favorable to the electric company on all the points involved. The old horse car line claimed to have been granted a monopoly of Winnipeg streets, but the decision sets this claim aside, and the electric railway will now proceed with numerous extensions to its system.

THE RELATIONS between the Niagara Falls Electric Railway, the Queen Victoria Park Company and the town of Niagara Falls were discussed thoroughly the other day in this city by representatives of the three respective interests mentioned. The chief points under discussion were the double tracking of the railway line, the condition of the roadbed between the rails, and the nature and maintenance of the road alongside the line at certain points. The ground was fully gone over and a substantial agreement reached on several points.

CONSIDERABLE DISCUSSION is going on at present in Toronto as to the possibility of establishing a direct street car service between the city and the island, and various schemes have been proposed with that object in view. The City Council has been giving the matter a good deal of attention, and several conferences have been held with the street railway company, but nothing very definite has as yet been done. A bridge from the Queen's wharf was suggested, but as the estimated cost of such a structure would be in the neighborhood of $150,000, the proposition has been dropped.

## English Notes.

(From our own Correspondent.)

LONDON, March 14, 1894.

AN ELECTRICAL PARCEL VAN.—The daily newspapers contain an announcement that an electrically driven van for the conveyance of parcels has been perambulating the streets of London with much ease, and attracting considerable attention from those interested in the matter. As a van of this kind must contain a heavy load of accumulators, motors, etc., and must be capable of steering amongst the crowded and narrow streets of the city, and of being pulled up sharply, even on the down gradient, it does not seem as if there was any probability of such vans becoming common. If they do, however, it is to be hoped that arrangements will be made to mitigate the anxiety generally depicted on the faces of those responsible for the driving of these cumbersome contrivances.

BRIGHTON.—This town, which was one of the first in the country to be lit by electric light, is now supplied with electric current for public and domestic lighting from the Corporation Electric Light Station. This is one of the most successful municipal stations in this country. During the last twelve months it has doubled the number of domestic consumers, and the rate of increase of the demand for current is still very great. One of the most interesting features of the Brighton system is the plan of differential charges which has been devised by Mr. Arthur Wright, the corporation electrical engineer.The object of this system is to encourage steady consumption of current. Up to a certain point, depending upon the maximum of current taken by the consumer, each consumer is charged at a maximum rate ; but beyond that point he is charged at only half this rate. The maximum current taken by each consumer is indicated by a "demand meter," the invention of Mr. Wright. This meter registers the maximum amperes taken by the consumer during the month, as well as indicating to the consumer by means of a scale the number of units he must consume before he can get the benefit of the lower price. This system has been found greatly to encourage the use of electricity in the private rooms in shopkeepers' houses.

DUPLEX SUBMARINE TELEGRAPHY.—An important case involving both a patent covering a system of duplex submarine telegraphy and an interesting point of patent law, came before the courts on Wednesday last. The action is brought by Messrs. Muirhead against the Commercial Cable Company, and has already occupied the attention of Queen's Bench Court III. for seven days, the best counsel of the bar being engaged on one side or the other. The Commercial Cable Company became licensees of Messrs. Muirhead under the United States patent of 1880, the agreement between the parties reciting the various patents taken out by these gentlemen, among them being the English patent No. 2564 of 1876, and an United States patent 234,490 of 1880; it being further agreed that any differences of opinion arising should be tried before an English court. The Commercial Cable Company allege that the American patent of 1880 contains nothing

more than one of the many methods of duplex working specified in the English patent of 1876, now expired. They therefore argue, that they are no longer under an obligation to pay royalty under the United States patent of 1880, since this, under the American patent law, must have expired contemporaneously with the English patent, of which it is, they argue, nothing more than a later edition. If the contention of the Commercial Cable Company is correct, they will relieve themselves from annual payments amounting in all to something like £45,000, their payments to the patentees running on under the American patent to 1897. It is somewhat curious that the question of the simultaneous expiring of an American with the earliest similar foreign patent, which has been the source of so much argument with you, should give rise to costly litigation in this country also, and that the action Bate Refrigerating Company v. Hammond, which has cropped up so frequently in electrical litigation in the United States, should be quoted in our own law courts.

# News of the Week.

## Telegraph and Telephone.

ATLANTA, GA.—A large delegation of telephone men connected with the Southern Bell Telephone and Telegraph Company held a meeting in Atlanta last week. The visiting delegation came to inspect the handsome new building, switchboard and underground system of the Atlanta Telephone Company, recently completed.

TOLEDO, OHIO.—Within the next week a patent suit involving $5,000,000 will be filed in the United States Court by the American Electric Company, of Toledo, against the Central Union Telephone Company, the Bell Telephone Company, and the Western Electric Company, of Chicago, for appropriating a multiplex switchboard invented by M. J. Carney, of this city.

LAGRANGE, IND.—The Lagrange and Rome City Telephone Company has been organized here by the election of D. A. Fawcett as president and J. E. Franks secretary. The line, twelve miles long, will be in operation within ten days, and President Fawcett says extensions willl be made to Kendallville, Fort Wayne and Goshen. The stock in the company is held at Lagrange, Kendallville and Fort Wayne.

## Electric Light and Power.

ASHEBORO, N. C.—An electric plant, boilers, etc., will be bought by B. J. Fisher.

BEAUMONT, TEX.—The Beaumont Ice, Light and Refrigeration Company is in the market for electrical machinery.

WEYMOUTH, MASS.—Residents are complaining of the quality and quantity of electric light now being furnished.

NEWTON, N. J.—A petition is now being circulated asking the authorities to issue bonds for an electric lighting plant, to cost about $4,000.

LOGANSPORT, IND.—The special electric light committee has made plans for a municipal electric light plant. William Dolan, of the committee, will give details.

MILWAUKEE, WIS.—Jacob Cloos, manager and electrician of the Manitowoc Electric Light Company for nearly five years, has resigned to accept the appointment of electrical engineer to the Pabst Heat, Light and Power plant.

ROODHOUSE, ILL.—The city of Roodhouse, Ill., is ready to receive bids for lighting the city, as per plans and specifications which have been adopted. The city will grant a franchise for from five to ten years. W. G. Armstrong is mayor.

BUFFALO, N. Y.—Architect Fred Mohr, of East Utica street, is making plans for important improvements for the property of the Elmwood Beach Improvement Company, on Grand Island, to include an electric lighting plant. William Ziegle, the Buffalo brewer, is interested and Charles Wagner, of Buffalo, will be manager.

## The Electric Railway.

HARTFORD, CONN.—Both Boards of Council have given the Hartford Street Railway permission to equip with the trolley system.

POTTSTOWN, PA.—Contactor Crilly has begun work on the trolley railway to connect Pottstown and Ringing Rocks, a distance of five miles.

McKEESPORT, PA.—The Citizen's Passenger Railway Company proposes to extend its lines this coming summer, but no details have been made public.

PHILADELPHIA, PA.—Jones & Wallace, of Wissahickon, Pa., have been awarded the contract for the proposed extension of the Wissahickon Electric Railway.

HENDERSON, KY.—The Henderson Electric Street Railway Company has decided to build three and one-half miles of electric road. E. G. Sebree, Jr., is manager.

WARREN. N. H.—An item is going the rounds of the press that a scheme is being pushed to build an electric railway from Warren, N. H., to the summit of Mount Moosilake,

CENTRAL FALLS, R. I.—The Town Council is considering the petition of the Pawtucket Electric Street Railway Company to lay a double track and operate cars on Broad street.

KANSAS CITY, MO.—Surveys have been completed for eight miles of the Westport and Waldo electric road. No contracts have yet been let. W. E. Winner, 415 American Bank Building, Kansas City.

STILLWATER, ILL.—The Stillwater Electric Railway Company will soon be sold at Sheriff's sale. It is reported that a stock company will be organized amongst the residents of Stillwater for the purchase of the road.

MEDINA, N. Y.—About the 1st of April work will be begun upon the proposed Batavia and Lake Ontario Railroad, of which Captain Beecher is president and J. W. Holmes, of Batavia, is chief engineer. It will be a one-track elevated road.

BALTIMORE, MD.—Daniel Keller and others of the Twelfth District have asked the Baltimore county commisioners for a renewal of the charter granted them for an electric railway from O'Donnell street, in Canton, to Keller's Pavilion, by way of Mount Carmel.

RALEIGH, N. C.—On the 14th of April, at the court house, will be sold at the instance of the Mercantile Trust and Deposit Company, of Baltimore, the property, rights of every kind and franchise of the Raleigh Street Railway Company. R. T. Gray, commissioner, Raleigh, N. C., will give details.

LITHIA SPRINGS.—An electric railway will be constructed to Lithia Springs from Atlanta, Ga. The eight miles of line to the Chattahoochie River will be constructed at once, and the remaining seven miles from the river to Lithia Springs later. The Chattahoochie River is to be crossed by electric launches like those in use at the World's Fair.

LAWRENCE, MASS.—The Lowell, Lawrence and Haverhill Street Railway Company has begun to relay its double tracks on Essex street, a work which was stopped last fall owing to the stringency in the money market. The double track extension to Barker's Grove, Methuen, will be started soon. Messrs. Soule & Dillingham, Boston, are the contractors.

BROOKLYN, N. Y.—W. A. Boland, of Boston, has secured the contract to construct 100 miles of street railroad through Brooklyn and suburban towns for the new Nassau electric railroad of this city. The contract calls for the completion of half of the system by July 15, and the remainder before the end of the year. Several other Boston capitalists are interested in the concern.

AUBURN, ME.—General Manager E. W. Gross has applied for right to erect poles and string wires for change of motive power to electricity for the Lewiston and Auburn Railway, and the matter has been referred to a special committee of three. Mr. Gross states that contracts for rails, etc., will be placed as soon as permission is granted.

DETROIT, MICH.—The Township Board of Springwells has granted to a Detroit syndicate, headed by Elmer T. Hance, postmaster of Detroit, a franchise to run an electric street railway on Michigan avenue from the city limits to the Dearborn line, to be completed within six months. The name of the new company will be the City and Suburban Traction Company.

LOCKHAVEN, PA.—The McDonough Construction Company, of New York, has offered to build a railway on the bond plan, Lockhaven to raise $10,000 on bond issue, and 60 per cent. of the stock to remain with the local company, which would control the road. L. M. Patterson, R. D. Peck and T. H. Harmon have been appointed a committee of Lockhaven citizens to raise $10,000 on issue of bonds by the road. It is proposed to bond the road for $100,000.

## Personal Notes.

PROF. E. L. NICHOLS will go to Europe in June on a year's vacation.

MR. J. J. CARTY delivered a lecture at Cooper Union on March 12 on "The Telephone," being one of the course of University Extension lectures.

MR. ALBERT L. CLOUGH read an able paper on electric rapid transit before the Manchester (N. H.) Board of Trade, on March 13, and urged the grant of an electric franchise for Manchester.

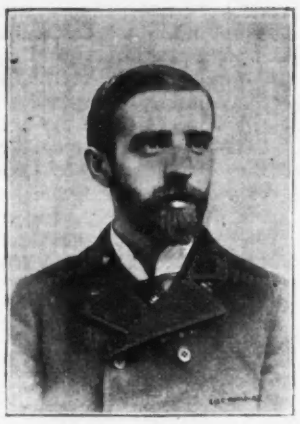
WILLIAM MAVER, JR., delivered a lecture at Cooper Union on March 19, on "Electric Alarms and Signals," being one of the University Extension Course lectures. Fire and burglar alarms, police patrol signals and railway electric block signalling were considered among others, and the complicated details of some of these little known systems were clearly and thoroughly explained.

MR. FREDERICK BATHURST is making a tour of the principal industrial countries of Europe in order to note the state of

electrical development in each as compared with the United States and England. He finds that Switzerland at the present moment is much ahead in the application of electricity to power and lighting, and has brought to practical perfection the simple and two and three-phased alternating systems.

MR. MAX LUHN, chief engineer of the Helios Company, of Cologne, Germany, and also manager of the company's branch office in Berlin, arrived March 25, on the American Line "New York," for a tour of inspection of the electrical features of the principal American cities. Mr. Luhn visited this country about eighteen months ago and made many friends, who will be glad of an opportunity of seeing him again, and learning more regarding the work his company is doing in Germany. His permanent address while in America will be in care of C. S. Chamberlain, Times Building, New York.

MR. H. F. PARSHALL, it was recently rumored contemplated leaving the employ of the General Electric Company and connecting himself with a well-known manufacturing firm. We are informed, however, that arrangements have been made by which Mr. Parshall is to continue with the General Electric Company in the capacity of consulting engineer. He is to sail for Paris the last of March and will spend several months in Europe in the interests of the company. Mr. Parshall, both by education and experience is well fitted for the line of work he has been following. He received his technical education in the universities of Cornell and Lehigh. His practical experience began with the Sprague Electric Railway and Motor Company, where he spent considerable time designing stationary and street car motors. For a brief period he was connected with the Wenstrom Dynamo and Motor Company, of Baltimore, and during that time designed what is claimed to be the first multipolar single reduction motor that was successfully operated in this country. The armature was of the ironclad type and drum wound and differed little from the best street car motors of to-day. He was engaged by the Edison General Electric Company as an engineer at the Schenectady works until the consolidation of the two great companies, since which time he has been at Lynn in charge of the calculating department, in which all the calculating and much of the designing work is done. Mr. Parshall is a member of the American Institute of Electrical Engineers and the American Institue of Mechanical Engineers and a lecturer at the Massachusetts Institute of Technology on Dynamo Design.



## Miscellaneous Notes.

THE ELECTRIC CLUB, of St. Louis, Mo., held its regular meeting on Saturday evening, the 24th inst., at 8:15. Mr. H. H. Humphrey read a paper on "Electrolysis," and a general discussion will follow. Some business matters of importance to the club will be presented.

THE UNIVERSITY OF WISCONSIN has announced the following special lectures and subjects in electrical engineering: Gilbert Wilkes, dynamo designing; A. V. Abbott, telephone switchboards; L. A. Ferguson, modern electric light stations; A. J. Rogers, electrolysis; Elisha Gray, the telautograph.

A FARM PLANT.—Mr. B. W. Philbrick, the electrical engineer of ex-Vice-President Morton's Ellerslie farm, has just finished installing the largest country installation in the world. Besides an immense lighting plant there are motors for all purposes, and 300 electro-thermostats in the barn, which building requires no less than 300 lights.

PRINCE BISMARCK is introducing the electric light in his palace at Friedrichsruhe, and has entrusted the work to the firm of Schuckert & Co., of Nuernberg, Germany. The power for the plant is to be obtained from a sawmill belonging to the Prince and located within a very short distance of the buildings in which the light is to be introduced.

THE ELECTRICAL SOCIETY, recently organized at Cornell University has been very successful, and great interest has been taken in its work, both by the students and the professors. It has now been decided that the papers read before the society will be published in book form. The volume will also contain the discussions. The publication will be issued towards the close of the college year—probably in May.

THE AMERICAN STREET RAILWAY CONVENTION, which is to meet in Atlanta in October next, will be most hospitably received by that city. Preparations are being made, and the place for the convention has been selected. It will be at Machinery Hall, in Piedmont Park, where, in addition to the rooms for the convention's session, there is ample building room for the numerous railway exhibits. Everything points to a successful meeting. The executive committee have met in Atlanta, and have adjourned after arranging preliminaries.

ELECTRIC BUOYS.—Captain W. S. Schley, and Lieutenant-Commander C. H. West, U. S. Navy, accompanied by Mr. Ira W. Henry, electrical engineer of the Bishop G. P. Co., started for Mobile, Ala., on March 25, to make a topographical survey of Mobile Bay and the adjacent shores to ascertain the practicability of lighting the thirty-mile channel with electric buoys and provide for the erection of the necessary generating plant. The successful operation of electric buoys for the last six years in New York Bay and the fine showing in Lake Michigan during the Fair have proven the adaptability of this work for harbor lighting, and opens up a new branch of lighthouse engineering.

## Trade and Industrial Notes

THE NOVELTY ELECTRICAL SUPPLY COMPANY, of Williamsport, Pa., has moved into new quarters on the ground floor of 330 West Fourth street.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., will furnish the iron roof for the new car barn for the Colonial Street Railway Company, of Kingston, N. Y.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 572 First avenue, N. Y., has issued circular No. 8, an illustrated price-list of blade switches of capacities from 35 to 1750 amperes.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, of Pittsburgh, Pa., has issued a circular describing and illustrating the Wurts non-arcing railway lightning arrester, recently placed on the market.

THE CHARLES PLUMB ELECTRICAL WORKS, 89 Erie street, Buffalo, N. Y., will, in addition to a regular supply business, manufacture and repair static electrical apparatus, frictional machines, physicians' electro-medical apparatus and electro-mechanical devices.

WELLS GOODHUE, 1564 Monadnock Block, Chicago, has succeeded to the business of the firm of Goodhue & Lincoln, dealers in high grade electrical material, Wagner slow speed motors and dynamos for direct and alternating currents, Sunbeam incandescent lamps, etc.

THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb street, St. Louis, Mo., recently organized, is meeting with flattering success, if substantial orders for batteries and cells can be considered as a criterion. This company is now fully equipped and in a position to execute orders of any size.

THE GREAT WESTERN MANUFACTURING COMPANY, of Chicago, is preparing for the market a new one-eighth horse power fan motor for 110-volt circuits with a 12-inch fan and wire guard.

THE WHEELER REFLECTOR COMPANY, 18 Washington street, Boston, Mass., has issued a 32-page catalogue of electric reflectors based upon the Wheeler system of special shapes for special uses. Many forms of reflectors are shown, including a new silver-plated mirror reflector for show rooms and windows.

FRANK H. STEWART, 1208 Green street, Philadelphia, is placing on the market a neat and efficient type of electric fan. The fans will be made with two and four blades for six and one-half and nine and one-half amperes arc and 110, 220 and 250 volt direct current circuits, and will be furnished nickeled or of polished brass.

THE WESTERN BUILDING AND LOAN ASSOCIATION, 227 South Clinton street, Chicago, Ill., has submitted its first annual report. All the officers of the association are, or have been, connected with the Western Electric Company for a number of years. It is claimed that the association has met with great success during the past year.

THE GERSON ELECTRICAL COMPANY, 4203 Walnut street, Philadelphia, Pa., has issued a "Telephone Catalogue" in which various styles of receivers and transmitters are described. Their standard instruments consist of the "Bell" main line magneto telephone with a Blake or carbon transmitter, and "warehouse" telephone, with the same kind of transmitter and receiver, but signalling by means of a switch and electric bell.

THE STANDARD PAINT COMPANY, 2 Liberty street, New York, is sending to its many friends samples of its ruberoid roofing. Ruberoid, combining as it does the good qualities of P. & B. Compound, is claimed to be "the thing" for the roofs of power houses and sheds. It is absolutely waterproof, is odorless, will resist fire, acids, and alkalies, and is not affected by contact with either steam, oil or gases. In fact, it is what has been for many years sought, a light, easily laid waterproof roofing.

H. B. COHO & CO., of the "Mail and Express" Building, 203 Broadway, New York, are now contractors for the apparatus manufactured by the Mather Electric Company, of Manchester, Conn., for New York City, Brooklyn and vicinity and New Jersey. Mr. Coho is well known through his connection with the Waddell-Entz company, as its sales agent, and proposes to make a strong fight for Mather business in his territory. Mr. Thomas C. Perkins,

vice president of the Mather Electric Company, who is in New York City much of the time, will also make his headquarters at 203 Broadway.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is just placing upon the market the Allen soldering stick—a soldering flux in solid stick form to take the place of resin, acids and soldering salts. It is put up in candles one inch in diameter and six inches long, and is applied by simply rubbing on the joint when heated.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY'S new telephone was recently tried between Newark and other points in New Jersey. It is claimed that during one conversation, carried on over an eight-mile line, the receiver at the Newark end was held at arm's length by one of the visitors and every one in the large room heard distinctly everything that was said over the line, some of those present being more than ten feet distant from the receiver. The tests included trials with several microphone carbon telephones, but the results with the Western instrument are claimed to be much more satisfactory.

FISHER & PORTER, 1025 Monadnock Block, Chicago, Ill., are equipping with machinery, for W. H. Roessle, of Pittsburgh, a gold mine at Tellico Plains, Tenn., and have supplied Kotine, a new material for painting iron structures, for the new Lincoln Park bridge, recently erected by the Pittsburgh Bridge Company. They have the contract to supply two 75-h. p. M. A. Green engines for the Leland Hotel, Chicago, and have several contracts of a similar nature, ready to be closed. They have advices from the home office of the Altoona Manufacturing Company, that the works are running full time with a complete complement of men, and are turning out engines as fast as their equipment will allow. One 150-h. p. engine for the Farmington Light and Power Company, Farmington, Ill., and one 125-h. p. engine for the Western Glass Company, of Colorado City, Col., are among the plants recently installed in the West. From the Providence Steam Engine Company they say word comes that the works are running day and night with a double turn of men in the construction of the improved Greene engine, of which they are the sole builders. There is evidently a demand abroad for engines and orders are being placed where they will receive the best attention.

## Business Notices.

**BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.**

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell ; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient and at prices lower than ever. THE HAYDEN-BOOKER MFG. CO., 2140 DeKalb St., St. Louis, Mo.

# Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED MARCH 13, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

516,188. ELECTRIC RAILWAY; M. W. Dewey, Syracuse, N. Y. Application filed July 6, 1889. This comprises a conduit having a movable coil therein in electrical connection with a source of electricity, a vehicle, means to cause the movable coil to follow the vehicle, a secondary circuit on the vehicle in inductionable relation to the coil, and a motor to move the vehicle in the secondary circuit.

516,198. AUTOMATIC HEAT REGULATING APPARATUS; C. F. Goodhue, Boston, Mass. Application filed May 11, 1893. This comprises a circuit adapted to render operative damper controlling mechanism, and embracing a thermostatic circuit closing device, a polarized relay having a vibratory armature, and a current reverser, and means for establishing the circuit independently of the thermostatic device.

516,204. MAGNETIZING COIL; J. D. Ihlder, Yonkers, N. Y. Application filed Nov. 18, 1893. As a means of producing a low rate of change of magnetic lines of force, a double magnetizing circuit in shunt relations to each other, and wound in opposite directions with terminals in permanent connection.

516,205. CABLE HANGER; A. E. Johnson, Wakefield, Mass. Application filed July 6, 1893. This comprises a metallic strip having tongue slots and provided at one end with a tongue having one or more finger openings, the strap having one or more locking fingers, one of the fingers being adapted to enter one of the finger openings after the tongue has been inserted through the tongue slots.

516,213. ALTERNATING CURRENT MOTOR; R. Lundell, Brooklyn, N. Y. Application filed July 30, 1892. An alternating current motor having a pair of current collecting brushes, one fixed and the other immovable, with a conductor connecting said brushes, the movable brush lying in a different plane from and adapted to be rotated past, the fixed brush. (See illustration.)

516,217. RHEOSTAT; H. McNulta, Bloomington, Ill. Application filed May 1, 1893. This consists of a pile of plates, each of which contacts with an adjacent plate by contact projections.

516,239. ELECTRICAL PROTECTION FOR SAFES; C. F. A. Sturts, San Francisco, Cal. Application filed April 11, 1893. This comprises an inclosing casing having a movable front, a lining for the casing composed of metallic sheets having interposed insulating material, one or more automatic circuit closers connected to both of the sheets and adapted to be closed by removing the removable front, and electrical connections to an alarm.

516,240. ELECTRICAL PROTECTION FOR WINDOWS; C. F. A. Sturts, San Francisco, Cal. Application filed April 11, 1893. The combination of a window and an alarm mechanism, of a molding connected to the window frame, parallel wires in the molding, and one or more spring contacts normally open, but adapted to make contact with both of the wires.

516,253. SECONDARY BATTERY; E. R. Whitney, Manchester, N. H. Application filed Feb. 4, 1893. This comprises a number of pans of insulating material, the bottom portion of each of which enters and closes the top portion of the one below, the pans having positive and negative plates supported on the inner and outer surfaces thereof, and connected therewith by electrical conductors passing through the bottom of the tray.

516,263. ELECTRIC MOTOR; O. F. Conklin, Dayton, Ohio. Application filed Jan. 9, 1893. The combination of a spider supported by the armature and having a space in the central vertical extension thereof; a switch attached to the extension within the space, the switch having two contact points; a field magnet having two sets of coils inclosed by the armature; a vertical rod and a cam loosely mounted thereon, whereby connection may be effected with one or both sets of field magnet coils.

516,298. DYNAMO-ELECTRIC MACHINE; F. J. Crouch, Portland, Ore. Application filed Feb. 27, 1893. The combination with a base frame of separable fields having flanged ends removably connected together, and means for vertically adjusting the connected fields within the base frame.

516,312. PROCESS OF ELECTRIC METAL WELDING; H. Lemp, and W. S. Moody, Chelsea, Mass. Application filed Oct. 20, 1890. This comprises a transformer having a secondary bar or conductor provided with an intermediate pole or electrode whereby it may constitute a divided source of energy.

516,336. CAR LIGHTING; W. M. Miner, Plainfield, N. J. Application filed Nov. 7, 1893. The combination of a branch from a main line exterior to the car, electric lamps in series in the branch, a storage battery in series with the lamps, and means controlled by the current flowing in the branch for closing and breaking the connection between the battery and one or more substitute lamps.

516,341. SAFETY DEVICE FOR ELECTROSTATIC MEASURING INSTRUMENTS; W. E. Ayrton and T. Mather, London, England. Application filed Sept. 7, 1893. The combination of a "safety terminal" having the metal parts inclosed in insulating material, safety fuse holder and an insulating and short-circuiting device.

516,374. CLOSED CONDUIT ELECTRIC RAILWAY; F. L. King, Chicago, Ill. Application filed May 5, 1893. The combination of an insulated conductor, a chamber inclosing the same, a cover for the chamber provided with armatures with a vehicle carrying magnets having their magnetic fields overlap and succeed each other.

516,379. SWITCH FOR SECONDARY BATTERIES; H. Muller, Nuremberg, Germany. Application filed Dec. 27, 1892. The combination with main sliding contacts and guideways for the battery, of auxiliary sliding contacts and guideways connected to the main contacts, and a voltmeter connected with the last named guideways so that the voltage of a single cell is indicated.

516,447. COMMUTATOR FOR ELECTRIC MACHINES; C. Olivetti, Ivrea, Italy. Application filed April 29, 1893. This comprises a commutator divided into a plurality of electrically separated parts, each part consisting of a series of commutator segments provided with intervening insulating spaces, brushes being provided for each electrically separated part of the commutator, the arrangement being such that the brushes of the same polarity shall have successive and continuous action.

516,478. ELECTRIC LOCK; J. R. Donnelly, Fairfield, Me. Application filed March 30, 1893. A combination keyboard having bars or poles connected with the wires of an electric circuit and push buttons, the poles of which are connected with movable arms adapted to be connected at will with the bars.

516,484. REGULATING SOCKET FOR INCANDESCENT LAMPS; M. D. Greengard, St. Louis, Mo. Application filed May 18, 1893. A socket having a resistance and connections, a revoluble shaft connected thereto, a friction disc carried by the shaft and a spring having its body in engagement therewith with sufficient force to hold the same and the shaft at different points in their movement.

516,487. ELECTRIC CURRENT REGULATOR; C. D. Haskins, Brooklyn, N. Y. Application filed April 1, 1889. The combination with a shifting brush carrier, of a frictional device to operate the brush carrier, and an electric motor in circuit with the dynamo to rotate the frictional device.

516,492. ELECTRIC TROLLEY DEVICE; C. Knapp, St. Louis, Mo. Application filed Nov. 20, 1893. This comprises a pole the terminal of which forms suitable bearing surfaces, suitable lugs on each side of the upper of the surfaces, and guards adjacent to each bearing surface for guiding the wire. (See illustration.)

516,495. SYSTEM OF CAR LIGHTING, HEATING, ETC.; I. N. Lewis, Fort Wadsworth, N. Y. Application filed July 15, 1893. In a railway car carried by a swiveling truck, the combination with a dynamo, power driven from the axle of the truck, of a transmitting shaft geared to the axle, and a bearing for the shaft carried by an arm or bracket mounted on the equalizing bars of the truck.

516,496. CAR LIGHTING; I. N. Lewis, Fort Wadsworth, N. Y. Application filed Sept. 6, 1893. The combination with a dynamo machine, of a reversible driving power, a compensating coil connected to the armature and adapted to oppose the rise of electromotive force from increase of speed, and a pole changer between the pole and armature.

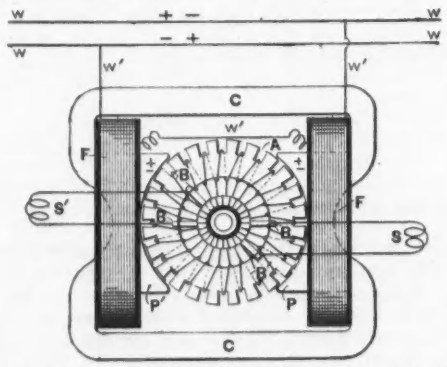
516,497. SELF-REGULATING DYNAMO; I. N. Lewis, Fort Wadsworth, N. Y. Application filed Sept. 8, 1893. The combination with a dynamo, driven by variable speed, of a magnet coil in the circuit of the armature wound or applied to tend to cut down the voltage of the armature when the current in the coil, due to increase of speed rises.

516,498. ELECTRIC SWITCH; I. N. Lewis, Fort Wadsworth, N. Y. Application filed Oct. 12, 1893. The combination of a separately excited dynamo and an electromagnetic pole changer controlling the connection thereof, with a working circuit and responsive to changes in the direction of the current supplied by the armature of the machine.

516,500. ELECTROMECHANICAL GONG; M. Martin, Malden, Mass. Application filed Aug. 8, 1893. This comprises a vibrating striking lever and controlling mechanism to engage and retain the lever stationary at the end of each vibration, combined with electromagnetically releasing mechanism for the controlling mechanism.

516,506. INTERIOR TELEPHONE SYSTEM; T. McCoubray, New York, N. Y. Application filed Dec. 4, 1893. A telephone pivotally secured to a portable base, in combination with switching contacts between the base and the telephone, whereby, when the latter is tilted to one side, the circuit connections are changed.

516,508. ELECTRIC HEATER; J. O'Meara, New York, N. Y. Application filed Dec. 22, 1892. This comprises a core supplied with a surrounding conductor insulated from the core and from




NO. 516,213.—ALTERNATING CURRENT MOTOR.

external objects, and its coils, insulated from each other, combined with a casing having laterally projecting flanges and a series of change tops applicable to such flanges, at pleasure, to increase or diminish the top surface.

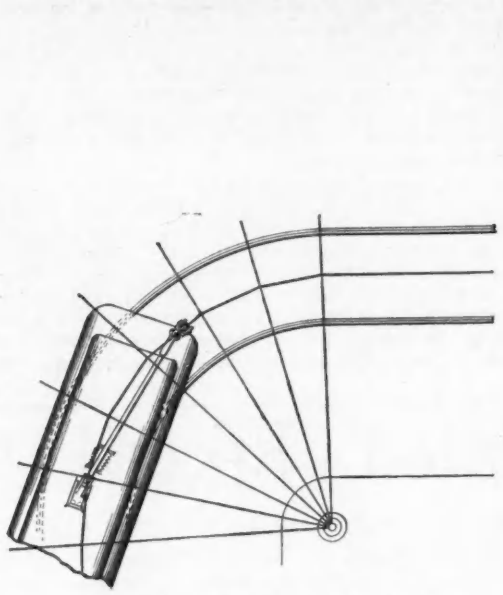
516,516. ELECTRIC MOTOR FOR STREET CARS; W. Baxter, Jr., Baltimore, Md. Application filed April 4, 1891. In combination with an electric motor having its field distorted and the wire space formed between its poles; of face plates on the sides of the poles to increase the cross section.

516,524. SUSPENDED ELECTRIC FAN MOTOR; J. F. Denison, New Haven, Conn. Application filed Jan. 9, 1893. An armature core comprising two castings, each consisting of a half rim and an arm extending inward from the center of the half rim and provided with an eye, through which the shaft passes.

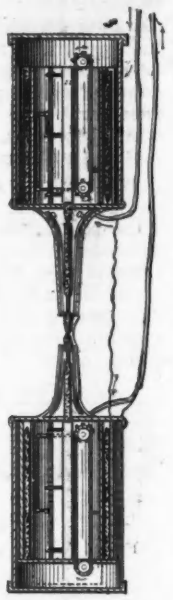
516,552. TELEGRAPH APPARATUS; J. A. Parker, St. Louis, Mo., and J. L. Summers, Chicago, Ill. Application filed Feb. 23, 1893. In an electric telegraph, a revolving contact drum, fixed stops at one end thereof, a space key and a lever connecting thereto and normally in contact with one of the stops.

516,553. ARMATURE FOR DYNAMO ELECTRIC MACHINES OR MOTORS; W. B. Sayers, Glenwood, Scotland. Application filed April 26, 1892. This comprises an armature having the sections of its winding connected to the commutator strips by commutator coils so wound upon the core that the current generated in each of them and in the adjacent armature section will be in the same direction.

516,558. AUTOMATIC BLOCK SIGNAL; J. D. Taylor, Chillicothe, Ohio. Application filed May 29, 1893. The combination



NO. 516,492.—TROLLEY DEVICE.



NO. 516,574.—ARC LAMP.

with a revoluble signal, of a source of light yielding to two light beams, the revoluble signal being arranged to eclipse the light beams in alternation.

516,565. ELECTRIC RAILWAY SUPPLY SYSTEM; J. D. Cummings, Detroit, Mich. Application filed Sept. 22, 1892. This comprises a contact device suspended from the car consisting of a supporting frame located in the conduit and a plurality of independently vertically and laterally movable travelers loosely mounted in the frame and arranged horizontally.

516,574. ELECTRIC ARC LAMP; F. L. McGahan, Indianapolis, Ind. Application filed Jan. 2, 1892. The combination of a casing, a spiral carbon magazine with springs therein for forcing the carbons to the center of the same, an opening in line with the centre through which the carbons are adapted to pass, spring arms for holding the carbons, means for feeding the same and circuit wires connected to the springs. (See illustration.)

516,597. SEMAPHORE SIGNAL; I. L. Green, Kittanning, Pa. Application filed July 22, 1893. The combination of a semaphore arm fulcrumed near one of its ends, a sleeve, a link pivotally connecting and end of said arm with the sleeve, and means for moving the sleeve rearward and thereby raising the arm to horizontal position.

516,596 ELECTRICAL RAILWAY SIGNAL; I. L. Green, Kittanning, Pa. Application filed July 22, 1893. The combination with a longitudinally movable arm, a means for locking the same in its rearward position and contacts brought into engagement with each other by the rearward movement of the arm, of a relay, and an electromagnet, the magnet serving to release the locking mechanism for the arm.

516,598. ELECTRICAL RAILWAY SIGNAL; I. L. Green, Kittanning, Pa. Application filed July 28, 1893. The combination with an arm, a shaft, a segment on said shaft, a rack bar engaged by the segment and connected with the arm, and a supplemental shaft adjacent to the first mentioned shaft, and a speed multiplier connecting the shafts together.

516,626. CLOSED CONDUIT ELECTRIC RAILWAY; E. H. Brown, Salem, Mass. Application filed April 22, 1893. Closed independent and separate sections, each forming a surface conductor, a section of a continual central rail, and an insulating inclosure, in combination with independent longitudinal switch contacts, each lying loosely within the inclosure.

516,631. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; W. Lawrence, New York, N. Y. Application filed May 2, 1893. This comprises a main conductor, a contact, a connection from the main conductor to the fixed part of the contact, a weighted lever carrying the movable part of the contact, a sectional working conductor, a rod connecting the moving conductor to the weighted lever, and a water tight casing inclosing the contacts and lever.